Environmental Assessment/ Overseas Environmental Assessment

of the SH-60R Helicopter/ALFS Test Program

October 1999

DEPARTMENT OF DEFENSE
DEPARTMENT OF NAVY

FINDING OF NO SIGNIFICANT IMPACT FOR PROPOSED SH-60R/AIRBORNE LOW FREQUENCY SONAR (ALFS) TEST PROGRAM

Pursuant to Council of Environmental Quality regulations (40 CFR Parts 1500-1508) implementing the procedural provisions of the National Environmental Policy Act (NEPA) and Presidential Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions,* the Department of the Navy gives notice that an Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) has been prepared and that an Environmental Impact Statement is not required for the testing of the SH-60R/Airborne Low Frequency Sonar (ALFS) in the established military ranges and training areas of Naval Air Station (NAS) Patuxent River Complex (PRC), Patuxent River, Maryland; Atlantic Warning Areas (AWA), off the coasts of Delaware, Virginia, and Maryland; Ex-USS *Salmon* site, off the New Jersey Coast; and Marine Corps Air Station (MCAS) Cherry Point, North Carolina.

The Proposed Action is to conduct developmental testing (DT) and operational testing (OT) for the SH-60R Program. Testing is required to assess the functional integration and operational suitability of the SH-60R, ALFS, and upgraded systems (e.g., improved common cockpit, advanced multi-mode radar, enhanced avionics, improved electronic support measures, nose-mounted forward looking infrared receiver/laser rangefinder designator, and integrated weapon systems). DT and OT will be conducted in phased intervals during the three-year period (1999-2001) in the established range and training areas of NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point. A total of approximately 568 flights, comprised of nearly 1,356 flight hours, are planned to successfully demonstrate DT and OT criteria. The use of stores will be required to support SH-60R and ALFS testing to include sonobuoys (active and passive), missiles (inert warhead, "live" solid rocket motor), decoys (chaff and flares), and small arms ammunition. The use of stationary and/or moving targets will also be used to support tests.

The following alternatives have been considered for the Proposed Action: the Preferred Alternative, the Minimum Requirements Alternative, Computer Simulation and Modeling, and the No Action Alternative. The Minimum Requirements Alternative and Computer Simulation and Modeling are not considered viable alternatives because they limit the ability of the Navy to meet testing and mission requirements, as defined in the Operational Requirements Documents for the SH-60R and ALFS. The No Action Alternative does not allow the Navy to adequately assess the capability of the SH-60R to meet the mission needs for an improved helicopter force structure. Furthermore, the evaluation of SH-60R system upgrades is essential for determining operational effectiveness of the instrumentation prior to Navy wide deployment. The No Action Alternative is not considered acceptable and is used only to define the baseline, existing environment at each of the Proposed Action test locations. Therefore, only two alternatives have been evaluated in the EA/OEA: the Preferred Alternative (the Proposed Action) and the No Action Alternative.

The following environmental resources/factors are not analyzed in the EA/OEA because impacts are expected to be low to negligible: geology and soils, land use, utilities, transportation, aircraft operations and safety, cultural, and environmental justice. Other environmental resources/factors are analyzed in the EA/OEA: air quality, water quality, noise (air and land), socioeconomics, coastal zone management, and biological. Effects are considered minor over the course of the entire testing program, given varied test event areas within each proposed location and varied test-period intervals within a calendar year. **(1) Air quality:** Criteria pollutant emissions do not exceed *de minimis* levels and are below applicable emission rates for nonattainment areas. A conformity analysis under 40 Code of Federal Regulations Part 51, Subpart W, is not triggered by implementation of the Proposed Action. A Record of Non-Applicability has been prepared for tests conducted at NAS PRC since a portion of the Chesapeake Test Range is located in nonattainment areas for ozone. **(2) Water quality:** Bay and ocean currents are expected to dilute and disperse any small increases in metal ions from corroding stores. Debris from plywood surface targets is recovered by test personnel or will biodegrade over time. Flare cardboard packaging is small and will biodegrade over time. Chaff is not expected to affect water quality or water resources based on previous research, which have studied the effects of chaff to the environment. **(3) Noise (Air and Land):** Air and land noise effects to human receptors, as well as wildlife and birds, from helicopter flights and missile firings are brief and of short duration. Proposed tests are similar in scope to existing aircraft operations and activities conducted at the proposed test locations. **(4) Socioeconomics:** The frequency and duration of each test event varies throughout the year, minimizing effects to daily, weekly, or monthly commercial fishing activities. **(5) Coastal Zone Management:** The entire SH-60R Test Program occurs within the bounds of existing facilities, target areas, and military ranges. The SH-60R Test Program will comply and be implemented, to the maximum extent practicable, in a manner consistent with State coastal zone policies. The Navy is currently coordinating with the Maryland Department of Environment and the North Carolina Department of Environment, Health, and Natural Resources, Division of Coastal Management, to confirm the determination that the Proposed Action is consistent with State coastal zone programs. *The SH-60R Test Program will not conduct active pinging of the ALFS system in the CTR until an official response has been obtained from the State of Maryland.* **(6) Biological:** There are four acoustic sources present during SH-60R tests that could potentially affect the underwater, marine environment: ALFS, AN/AQS-13F sonar system, AN/SSQ-62 sonobuoys, and helicopter engine/machinery noise. Potential effects to biological resources from the Proposed Action, either direct or cumulative, would be minor. Aircraft noise is not expected to affect marine mammals significantly because the most conservative estimate of in-water near-surface total energy level is below even the most sensitive behavior modification level for marine mammals. Although sea turtles can be found in very low densities, their hearing thresholds are suspected to be well below the frequencies produced by ALFS; and therefore, no effects is expected on sea turtles. The use of modeling, in conjunction with behavior modification and temporary threshold shift levels for marine mammals and animal density information, demonstrates limited zones of influence (ZOIs) for marine mammals at the Proposed Action test locations.

Visual and passive acoustic monitoring will further reduce the potential for impacting the marine environment at the proposed test sites and will significantly reduce the estimates of number of animals potentially affected for a single transmission of the acoustic source. Individuals (i.e., pilots, spotters, or other test participants) that have been trained by the Navy, Coast Guard, or other qualified organizations in marine mammal identification will conduct visual monitoring of marine mammals from the helicopters in each of the proposed test locations. If marine mammals are visually identified within the ZOIs, active transmissions from the acoustical systems will not begin or will be suspended until the animal(s) have left the area. Passive acoustic monitoring will also occur simultaneously with visual monitoring. Passive acoustic monitoring can provide an indicator of the presence of vocalizing marine mammals in proximity to the active sonar systems. The ALFS transducer will be used in a passive mode prior to initiating any active transmissions. If marine mammals are detected, visual observers will be cued to the estimated location of the vocalizations, and all active transmissions suspended if the observers positively confirm the presence of marine mammals. Implementation of the Proposed Action is, therefore, not expected to have any significant cumulative effects on marine mammal species or other environmental resources.

Based on information gathered during preparation of the EA/OEA, the Navy finds that the SH-60R/ALFS Test Program at NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point will not significantly affect the environment. In the interim of receiving an official coastal zone consistency determination from the State of Maryland, the SH-60R Test Program will not conduct active pinging of the ALFS System in the CTR. In accordance with EO 12114 and based on information gathered during preparation of the EA/OEA, the Department of the Navy finds that the SH-60R/ALFS Test Program at NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point will not result in significant harm to resources of the global commons. The EA/OEA prepared by the Navy addressing this action may be obtained from: Commanding Officer, Attn: Joan Hinson, Public Affairs Office, Building 504, 22445 Peary Road, Naval Air Station, Patuxent River, Maryland, 20670, telephone (301) 757-4814.

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Environmental Assessment/
Overseas Environmental Assessment
of the
SH-60R HELICOPTER/ALFS TEST PROGRAM

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EXECUTIVE SUMMARY

The Department of the Navy (DoN), or Navy, currently has a need to streamline and consolidate the existing helicopter force structure to meet present and future antisubmarine warfare (ASW), antisurface warfare (ASuW), mine warfare, combat search and rescue (SAR), special operations, and vertical replenishment mission areas. The Navy has also identified an additional need to improve current mid-frequency dipping sonar systems for advanced ASW capabilities and new undersea warfare (USW) requirements. As such, the Navy has identified the SH-60R and the Airborne Low Frequency Sonar (ALFS) as the requisite systems meeting these needs. The SH-60R has been designated as the Navy's only platform for integrating and deploying the ALFS.

The Proposed Action is to conduct developmental testing (DT) and operational testing (OT) for the SH-60R Program. The purpose of DT and OT by the Navy is to demonstrate the capability and improved effectiveness of the SH-60R in performing ASW, ASuW, SAR, and other related missions. Testing is required to assess the functional integration and operational suitability of the SH-60R, ALFS, and upgraded systems (e.g., improved common cockpit, advanced multi-mode radar (MMR), enhanced avionics, improved electronic support measures (ESM), nose-mounted forward looking infrared receiver/laser rangefinder designator, and integrated weapon systems). The directive of DT is to ensure that technical specifications and operating criteria have been successfully designed and built into the SH-60R's systems. OT is required to verify the operation of the SH-60R from a fleet perspective and to further resolve any problems identified during DT. DT and OT also evaluate overall safety and maintainability of the SH-60R and its systems prior to deployment to the fleet.

This Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) analyzes the potential environmental impacts of the Proposed Action, DT and OT of the SH-60R helicopter and ALFS. This EA/OEA has been prepared pursuant to:

- National Environmental Policy Act (NEPA) of 1969, which requires an environmental analysis for major Federal actions that may have the potential to impact the quality of the human environment;
- Council on Environmental Quality regulations in 40 Code of Federal Regulations Parts 1500-1508, which implement the requirements of NEPA;
- Presidential Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*, which requires an environmental analysis for major actions conducted outside the United States (U.S.) to determine if there is a potential for significant environmental impacts; and
- Chief of Naval Operations Instruction 5090.1B, which delineates the Navy's internal operational procedures on how to implement the provisions of NEPA and EO 12114.

The provisions of NEPA apply to major Federal actions that occur in the U.S. and within 22 kilometers (km) (12 nautical miles (nm)) from its shores. The provisions of EO 12114 apply to major Federal actions that occur beyond 22 km of the U.S., in the global commons, or within the jurisdiction of a non-participating foreign government. Both NEPA and EO 12114 apply to this Proposed Action because DT and OT will be conducted within and outside the U.S. territory. Therefore, a combination of an EA and an OEA has been prepared to address the potential environmental impacts from implementing the Proposed Action.

The Navy proposes to conduct DT and OT at various time periods from 1999 to 2001. Test events will be conducted in phased intervals during the three-year period. A total of approximately 568 flights, comprised of approximately 1,356 flight hours, are planned to successfully demonstrate DT and OT criteria. Tests conducted can be categorized into five major components: ALFS, Navigation Systems, Integrated Self-Defense (ISD) Systems, MMR, and ESM Systems. Individual test events will vary depending upon the test criteria and mission scenarios, which must be demonstrated by the SH-60R. The use of stores will be required to support SH-60R and ALFS testing. Planned stores include the use of sonobuoys (active and passive), missiles (inert warhead, “live” solid rocket motor), decoys (chaff and flares), and small arms ammunition. The use of stationary and/or moving targets will also be used to support tests.

Selection of the preferred locations for the Proposed Action is based on DT, OT, and range requirements. The range combinations selected must support specific criteria for key components of the SH-60R testing program as highlighted in Table ES-1. Other critical screening criteria include costs (e.g., personnel, equipment, and facilities), transit time to test locations within established installations and ranges, and adequate facilities to support aircraft tests (e.g., hangars for maintenance, 400 Hertz electrical power, tow tractors, etc.). Cost and transit times must be minimized to reduce impacts to funding constraints and to maximize test data collection. In addition, ocean bottom topography and shallow/deep water locations are necessary to allow for flexible test planning and mission scenarios.

Table ES-1:
Test Screening Criteria Summary

SH-60R Key Test Components	Primary Range/Test Requirements
Airborne Low Frequency Sonar (ALFS)	➢ Instrumentation capability for simultaneous tracking of underwater contacts, surface vessels, sonobuoys, and aircraft ➢ Range size to support joint operations with Navy submarines and allow for ALFS/SH-60R detection, localization, and tracking performance ➢ Shallow and deep water capabilities ➢ Surface vessel capability to deploy and recover mines, transducer arrays, and other test equipment ➢ Fixed sonar transducer capability to trigger and respond to ALFS test frequencies ➢ Submerged, stationary diesel submarine

**Table ES-1 (continued):
Test Screening Criteria Summary**

SH-60R Key Test Components	Primary Range/Test Requirements
Navigational Systems	➢ Instrumentation capability (beacon, laser retro-reflector, real-time recording) ➢ Land (including wet grassy areas) and water (various wave heights) testing capabilities for radar altimeter testing ➢ Radar and barometric altitude, true airspeed, ground speed, and ground track accuracy support critical
Integrated Self-Defense (ISD) Systems	➢ Instrumentation capability for aircraft tracking ➢ Threat simulation capabilities for electronic warfare, infrared, and laser threat signatures ➢ Range for countermeasure deployments to include chaff and flares and aircraft lasing ➢ Full complement of actual and replicated sea and land-based threat system capabilities
Multi-Mode Radar (MMR)	➢ Instrumentation capability for simultaneous tracking of airborne and surface targets and test aircraft ➢ Range size to support joint operations with Navy submarines and allow for MMR/SH-60R detection, localization, and tracking performance ➢ Surface vessel capability to deploy and recover special radar targets and other test equipment ➢ Periscope detection test capabilities
Electronic Support Measures (ESM)	➢ Instrumentation capability for aircraft tracking ➢ Electronic warfare threat simulation capability

Four alternatives have been considered for the Proposed Action: the Preferred Alternative, the Minimum Requirements Alternative, Computer Simulation and Modeling, and the No Action Alternative.

(1) The Preferred Alternative is to conduct SH-60R DT and OT at a combination of established Department of Defense (DoD) military facilities and ranges. Various test sites have been reviewed using the selection criteria summarized in Table ES-1. The Navy has determined that the selected sites listed in Table ES-2 are the most suitable because they are established ranges with the required facilities, equipment, qualified personnel, and range technical attributes available to conduct the full spectrum of DT and OT scenarios. The SH-60R Program has found these preferred alternative test locations to be the most efficient use of DoD and Navy facilities and resources, thereby minimizing program schedule risks and greater costs.

Table ES-2:
Preferred Alternative Test Locations

Range Site	DT	OT
Naval Air Station Patuxent River Complex (NAS PRC), Patuxent River, MD	✓	✓
Atlantic Warning Area (AWA)	✓	✓
Ex-USS *Salmon* Site	✓	✓
Atlantic Undersea Test and Evaluation Center (AUTEC), Andros Island, Bahamas	✓	✓
Marine Corps Air Station (MCAS) Cherry Point, NC	✓	
Poinsett Weapons Range, Shaw Air Force Base (AFB), SC		✓

(2) The Minimum Requirements Alternative is to use a minimum combination of other possible ranges. No single range can satisfy all of the test requirements nor can a different combination of selected ranges achieve the costs and transit criteria for the Proposed Action. The test screening selection process indicated, for example, that ISD System tests could be conducted at Naval Air Warfare Center, Weapons Division China Lake. However, the longer transit time, greater costs for deploying support personnel and equipment to the facility, and the inability to provide appropriate environmental data and atmospheric conditions make this location unacceptable by limiting the ability to perform necessary criteria tests and providing less flexibility for Navy needs. The Minimum Requirements Alternative is not preferred because it limits the ability of the Navy to adequately assess all components of the SH-60R Test Program, increases tests costs substantially, and minimizes the flexibility for Navy testing needs. Thus, this alternative is not analyzed further in this EA/OEA.

(3) Computer Simulation and Modeling can be used to infer system performance. The SH-60R and ALFS Programs have used computer imagery, simulation, and modeling to the maximum extent possible as part of the systems engineering and design process. However, this is not a preferred alternative because it limits the Navy's ability to meet testing and mission requirements, as defined in the Operational Requirements Documents for the SH-60R and ALFS, prior to approving the aircraft system for production and release to the fleet. Therefore, this alternative is not analyzed further in this document.

(4) Under the No Action Alternative, the Navy would not conduct DT and OT of the SH-60R and ALFS. This alternative is not considered acceptable because it does not allow the Navy to adequately assess and validate the capability of the SH-60R and its systems to meet ASW, ASuW, USW, and other mission needs. Testing is necessary and part of the Navy's approval process for aircraft system production and release to the fleet. However, the No Action alternative is used to define the baseline, existing environment at each of the Preferred Alternative test locations.

For the purposes of this EA/OEA, the proposed SH-60R and ALFS tests at Atlantic Undersea Test and Evaluation Center (AUTEC) are not analyzed because they are similar in scope to the operations addressed in the EO 12114 documentation for AUTEC. The potential environmental impacts and any mitigation measures required for the Proposed Action at AUTEC are covered in the *Final Environmental Review for the Adoption of a Range Management Plan for the Atlantic Undersea Test and Evaluation Center (AUTEC), Andros Island, Bahamas, 1997* and AUTEC's *Operating Control Directive for Range Operations Environmental Mitigation Procedures, 1999*. Likewise, the potential environmental impacts for tests at Poinsett Weapons Range, Shaw AFB have not been analyzed because the scope and extent of the test events planned for 2001 have not been sufficiently defined for the Proposed Action. Once details of the proposed ESM System tests have been completed, the SH-60R Program will supplement this EA/OEA to address potential environmental effects at Poinsett Weapons Range, Shaw AFB.

The following environmental resources/factors are potentially affected by the Proposed Action: air quality, water quality, noise (air and land perspective), socioeconomics, coastal zone management, and biological. These resources are analyzed in this EA/OEA by providing a concise description of the baseline environment at each proposed test location and then by assessing the significance of impacts to the environment from implementation of the proposed SH-60R/ALFS DT and OT Program. Other environmental resources/factors, as follows, are not analyzed in this EA/OEA because impacts are expected to be low to negligible: geology and soils, land use, utilities, transportation, aircraft operations and safety, cultural, and environmental justice. Of the environmental resources/issues analyzed, the predominant resource of concern from implementing the Proposed Action is biological, specifically the potential impacts to marine species. The primary focus of the analysis has, therefore, been on the potential effects of man-made underwater sound on marine mammals and sea turtles from test events involving low altitude flights by the SH-60R and/or the use of active acoustic systems (ALFS, AN/AQS-13F sonar system, and AN/SSQ-62 sonobuoys).

Under the No Action Alternative, there would be no changes or impacts to the baseline environment at each proposed test location. Potential impacts from implementing the Proposed Action are not expected to be significant for air quality, water quality, noise (air and land perspective), socioeconomics, and coastal zone resources. Effects are considered minor over the course of the entire testing program (given varied test event areas within each proposed location and varied test period intervals within a calendar year) and are briefly summarized in Table ES-3. The Navy is currently coordinating with the Maryland Department of Environment and the North Carolina Department of Environment, Health, and Natural Resources, Division of Coastal Management, to confirm the determination that the proposed SH-60R Test Program does not significantly impact coastal zone resources.

Table ES-3:
Potential Impacts to Environmental Resources/Issues

Air Quality	Criteria pollutant emissions do not exceed *de minimis* levels and are below applicable emission rates for nonattainment areas. A conformity analysis under 40 Code of Federal Regulations (CFR) Part 51, Subpart W, is not triggered by implementation of the Proposed Action. A Record of Non-Applicability (RONA) has been prepared for tests conducted at NAS PRC since a portion of the Chesapeake Test Range is located in nonattainment areas for ozone.

**Table ES-3 (continued):
Potential Impacts to Environmental Resources/Issues**

Water Quality	Bay and ocean currents are expected to dilute and disperse any small increases in metal ions from corroding stores. Debris from plywood surface targets is recovered by test personnel or will biodegrade over time. Flare cardboard packaging is small and will biodegrade over time. Chaff is not expected to affect water quality or water resources based on previous research which have studied the effects of chaff to the environment.
Noise (Air and Land)	Air and land noise effects to human receptors, as well as wildlife and birds, from helicopter flights and missile firings are brief and of short duration. Proposed tests are similar in scope to existing aircraft operations and activities conducted at the proposed test locations.
Socioeconomics	The frequency and duration of each test event varies throughout the year minimizing effects to daily, weekly, or monthly commercial fishing activities.
Coastal Zone Management	Continued adherence to current environmental protection programs minimizes impacts to coastal zone resources. The short duration of ALFS use in the CTR at NAS PRC, visual/passive monitoring for marine mammals and turtles, and low likelihood of encountering these species minimizes the potential for adverse effects to marine mammals and turtles. The SH-60R Test Program will comply and be implemented, to the maximum extent practicable, in a manner consistent with State coastal zone policies.
Biological	Potential effects to biological resources from the Proposed Action, either direct or cumulative, would be negligible. Mitigation measures would be implemented to further reduce any potential effects.

The potential effects on marine mammals specifically depend on the general acoustic source specifications (source level, frequency, beam patterns, etc.), the depth at which the source will transmit, and the acoustic environment (i.e., acoustic propagation characteristics) of the test sites. This information, when combined with the acoustic received levels at which the marine animals exhibit behavior modification or Temporary Threshold Shift (TTS) in their hearing, allows the determination of zones of influence (ZOIs) for each of the acoustic sources. There are four acoustic sources present during proposed DT and OT, which could potentially affect the underwater, marine environment: ALFS, AN/AQS-13F sonar transducer, AN/SSQ-62 sonobuoys, and helicopter engine or machinery noise, which enters the water through the sea surface. Aircraft noise is not expected to affect marine mammals significantly because the most conservative estimate of in-water near-surface total energy level is 156.2 decibels (dB). This level is below even the most sensitive behavior modification level for marine mammals (i.e., 160 dB for mysticetes).

The three active sonars transmit in slightly different frequency bands. However, these frequencies are close enough that the received level values used to calculate the ZOIs for behavioral modification and TTS in marine mammals are identical for the three sources. Therefore, effectively, the only difference in these calculations is the source level for each sonar system. Since the ALFS source is the strongest, it has been used in the analyses and calculations for ZOIs. It conservatively approximates the effects of the AN/AQS-13F sonar and AN/SSQ-62 sonobuoys. The Parabolic Equation (PE) Model, Version 3.4 (an acoustic propagation loss model from the Navy's Oceanographic and Atmospheric Master Library) has been used to analyze and determine potential effects on marine mammals.

The PE Model, in conjunction with animal density information, demonstrates limited ZOIs for marine mammals at each of the following test locations where active acoustic systems (ALFS, AN/AQS-13F sonar transducer, and AN/SSQ-62 sonobuoys) will be used for test events: NAS PRC, AWA, and Ex-USS *Salmon* site (Office of Naval Research, 1997a-c). It is believed that mysticetes could possibly experience a behavioral effect at received levels greater than or equal to 160 dB referenced to (re) 1 microPascal (μPa) and a TTS at received levels greater than 180 dB re 1 μPa. Odontocetes and pinnipeds could possibly incur a behavioral response if the received sound is greater than or equal to 186 dB re 1 μPa and TTS at received levels greater than or equal to 194 dB re 1 μPa. Although sea turtles can be found in very low densities near the proposed test sites, their hearing thresholds are suspected to be well below the 3-5 kilohertz (kHz) frequencies produced by ALFS or the 6-10 kHz frequencies produced by the AN/AQS-13F or the AN/SSQ-62. Sea turtle auditory systems have not been well studied, but Ridgway et al. (1969) concluded that the upper auditory limit for one species (green turtle) is only 1 kHz with maximum sensitivity at 300 to 400 Hz. Therefore, the potential for any behavioral or TTS effects on sea turtles is negligible and has not been analyzed further in this EA/OEA.

Individuals (i.e., pilots, spotters, or other test participants) that have been trained by the Navy, Coast Guard, and/or other qualified organizations in marine mammal identification will conduct visual monitoring of marine mammals from the helicopters in each of the proposed test locations. If marine mammals are visually identified within the ZOIs (see Table ES-4), active transmissions from the acoustical systems will not begin or will be suspended until the animal(s) have left the area. The SH-60R conducts operations at a given location on the order of tens of minutes, and while the SH-60R is performing the tests, the chase aircraft will maintain watch at a higher altitude, thereby ensuring adequate coverage of the ZOIs. The effectiveness of visual monitoring is estimated to be excellent due to the fact the SH-60R and chase helicopters provide a very good platform to conduct visual surveys. The aircraft's height above the water, its ability to hover in place, and its nearly 100 percent unobstructed view ensure excellent viewing of the surrounding water. Additionally, all of the tests that include acoustic transmissions will be conducted during the day. There does exist the possibility of a deep diving animal or an animal that has been submerged for a long period of time, and therefore not available for visual observation, surfacing in a ZOI. Animals with this type of behavior are typically the large odontocetes, whose ZOIs are 457 m (500 yards) or less. Additionally, the greater visual-observation ranges afforded by the SH-60R and other H-60 aircraft minimize this possibility. Passive acoustic monitoring will also occur simultaneously with visual monitoring. Passive acoustic monitoring can provide an indicator of the presence of vocalizing marine mammals in proximity to the active sonar systems. The ALFS transducer will be used in a passive mode prior to initiating any active transmissions. If marine mammals are detected, visual observers will be cued to the location of the vocalizations, and all active transmissions suspended if the observers positively confirm the presence of marine mammals. Multiple pings that an individual animal may potentially receive is unlikely and no significant impact is expected. The potential for entanglement of marine mammals with the dipping sonar's cable and with sonobuoys is considered a remote probability.

Table ES-4:
ZOIs (nm) for ALFS at Proposed Test Sites

NAS PRC	**Year Round**							
Species	**Behavior**				**TTS**			
Mysticetes	0.5				0.03*			
Odontocetes	0.03*				0.005 *			
Pinnipeds	0.03*				0.005 *			
AWA	**Fall/Winter**				**Spring/Summer**			
	Deep Source (> 400 ft)		Shallow Source (< 400 ft)		All Source Depths			
Species	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**		**TTS**	
Mysticetes	0.35	0.03*	0.5	0.03*	0.35		0.03*	
Odontocetes	0.03*	0.005*	0.03*	0.005*	0.03*		0.005*	
Pinnipeds	0.03*	0.005*	0.03*	0.005*	0.03*		0.005*	
Ex-USS *Salmon* Site	**Fall/Winter**				**Spring/Summer**			
	Deep Source (> 200 ft)		Shallow Source (< 200 ft)		Deep Source (> 100 ft)		Shallow Source (< 100 ft)	
Species	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**
Mysticetes	0.35	0.03*	0.5	0.03*	0.5	0.03*	0.35	0.03*
Odontocetes	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*
Pinnipeds	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*

* For acoustic environments that did not have a surface duct but did have water depths that supported spherical spreading, the acoustic analysis was conducted using the transmission loss equation for spherical spreading [20 log (R)].

In summary, the effectiveness of the mitigation measures (visual and passive acoustic monitoring), combined with the small calculated ZOIs (especially for the odontocetes and pinnipeds) and the low duty cycles for the sonar sources, make the possibility of an endangered or threatened marine mammal being in the ZOI for any active sonar negligible. It is the intent of the SH-60R and ALFS Programs to implement these mitigation measures to minimize any marine mammal from entering the ZOI of an active sonar and/or to suspend transmissions from that sonar system until the marine mammal has departed from the ZOI. Implementation of the Proposed Action is not expected to have any significant cumulative effects on marine mammal species or other environmental resources/issues. **Therefore, pursuant to NEPA, the Navy concludes with a Finding of No Significant Impact for the Proposed Action, DT and OT of the SH-60R and ALFS at NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point. Likewise, in accordance with EO 12114, the Navy finds that the SH-60R/ALFS Test Program at NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point will not result in significant harm to the resources of the global commons.**

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

List of Appendices

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ACRONYMS AND ABBREVIATIONS

°	Degrees
$	Dollar(s)
#	Number
%	Percent
AAM	Annual Arithmetic Mean
AFB	Air Force Base
ALFS	Airborne Low Frequency Sonar
ASuW	Antisurface Warfare
ASW	Antisubmarine Warfare
ATIRCM	Advanced Tactical Infrared Counter Measures
AWA	Atlantic Warning Areas
AUTEC	Atlantic Undersea Test and Evaluation Center
BCH	Beach
BM	Brackish Marsh
BT	Bathythermograph
C	Celsius
CA	California
CAA	Clean Air Act
CAMA	Coastal Area Management Act
CEQ	Council on Environmental Quality
CeTAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	centimeters
CO	Carbon Monoxide
CRMP	Coastal Resources Management Program
CTR	Chesapeake Test Range
CZ	Convergence Zone
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
CZMARA	Coastal Zone Management Act Reauthorization Amendments
dB	Decibel
dB(A)	A-Weighted Decibel Scale
DCMP	Delaware's Coastal Management Program
DE	Delaware

DI	Dynamic Interface
DICASS	Directional Command Activated Sonobuoy System
DIFAR	Directional Frequency and Ranging
DoD	Department of Defense
DoN	Department of the Navy
DT	Developmental Testing
E	East
E3	Electromagnetic Environmental Effects
EA	Environmental Assessment
ECM	Electronic Counter Measures
EIS	Environmental Impact Statement
EM&A	Ecosystem Management & Associates, Inc.
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESM	Electronic Support Measures
EU	Electronics Unit
EW	Electronic Warfare
F	Fahrenheit
FACSFAC	Fleet Area Control and Surveillance Facility
FL	Florida
FLIR	Forward Looking Infrared Receiver
FLIR/LRD	Forward Looking Infrared Receiver/Laser Rangefinder Designator
ft	Foot or Feet
FY	Fiscal Year
GPS	Global Positioning System
h	Hour(s)
HCU	Hand Control Unit
HI	Hawaii
Hz	Hertz (cycles per second)
IFF	Identification Friend or Foe
in	Inch(es)
ISAR	Inverse Synthetic Aperture Radar
ISD	Integrated Self-Defense
ISSI	ISSI Consulting Group
IUCN	International Union for Conservation of Nature and Natural Resources

K	Thousand
kg	Kilograms
kt	Knot(s)
kHz	Kilohertz
km	Kilometer
Km^2	Square kilometers
km/h	Kilometers Per Hour
lb	Pound(s)
L_{dn}	Day-Night Noise Level
LF	Low Frequency
LOFAR	Low Frequency and Ranging
LRD	Laser Rangefinder Designator
m	Meter(s)
MAB	Mid-Atlantic Bight
MAI	Marine Acoustics, Inc.
MCAS	Marine Corps Air Station
MD	Maryland
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MF	Mid-Frequency
$\mu g/m^3$	Micrograms Per Cubic Meter
µm	Micrometer(s)
µPa	MicroPascal(s)
mg/L	Milligrams Per Liter
mi	Mile(s)
mi^2	Square miles
min	Minute(s)
MMPA	Marine Mammal Protection Act
MMR	Multi-Mode Radar
mph	Miles Per Hour
msec	Millisecond(s)
MST	Maritime Shrub Thicket
MUTES	Multiple Threat Emitter System
N	North
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
NAS PRC	Naval Air Station Patuxent River Complex
NASA	National Aeronautics and Space Administration
NATOPS	Naval Air Training and Operating Procedures
NAWCWD	Naval Air Warfare Center, Weapons Division

NC	North Carolina
Nd	Neodymium
Nd:YAG	Neodymium Yttrium Aluminum Garnet
NEPA	National Environmental Policy Act
NJ	New Jersey
nm	Nautical Mile(s)
NMFS	National Marine Fisheries Service
NO_x	Nitrogen Oxides
NSWC	Naval Surface Warfare Center
NUWC	Naval Undersea Warfare Center
NVG	Night Vision Goggle
NY	New York
O_3	Ozone
OEA	Overseas Environmental Assessment
OPNAVINST	Chief of Naval Operations Instruction
OT	Operational Testing
OW	Open Water
Pb	Lead
PE	Parabolic Equation
pH	Acidity/Alkalinity
PM_{10}	Particulate Matter 10 Microns or Less in Diameter
PMRF	Pacific Missile Range Facility
ppm	Parts Per Million
ppt	Parts Per Thousand
PRC	Patuxent River Complex
RADAR	Radio Detection and Ranging
re	Referenced To
RF	Radio-Frequency
RDT&E	Research, Development, Testing, and Evaluation
RONA	Record of Non-Applicability
s	Second(s)
S	South
SAR	Search and Rescue
SC	South Carolina
SC	Species of Concern
SCORE	Southern California Offshore Range
SEPTAR	Seaborne Powered Target
SHP	Shaft Horse Power
SIP	State Implementation Plan
SL	Source Level

SLAM	Standoff Land Attack Missile
SM	Boresight Module
SNE	Southern New England Area
SO_2	Sulfur Dioxide
SR	Significantly Rare Species
SVP	Sound Velocity Profile
T	Threatened
TBD	To Be Determined
TOTO	Tongue of the Ocean
tpy	Tons Per Year
TRAINS	Threat Reaction and Indicator System
TRTG	Tactical Radar Threat Generator
T S/A	Threatened by Similarity of Appearance
TTS	Temporary Threshold Shift
TU	Turret Unit
U.S.	United States
UHF	Ultra-High Frequency
USC	United States Code
USFWS	United States Fish and Wildlife Service
USS	United States Ship
USW	Undersea Warfare
VA	Virginia
VACAPES	Virginia Capes
VHF	Very-High Frequency
VLAD	Vertical Line Array DIFAR
VOC	Volatile Organic Compound
W	West
WA	Washington
W/m^2	Watts Per Square Meter
YAG	Yttrium Aluminum Garnet
ZOI	Zone of Influence

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1. PURPOSE AND NEED FOR THE PROPOSED ACTION

This Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) analyzes the potential environmental impacts of developmental testing (DT) and operational testing (OT) of the SH-60R helicopter and the Airborne Low Frequency Sonar (ALFS), an active antisubmarine warfare sensor. The Department of the Navy (DoN), or Navy, is the lead agency for the decision regarding testing of the SH-60R/ALFS.

This EA/OEA analyzes the potential environmental impacts of the Proposed Action and has been prepared pursuant to:

- National Environmental Policy Act (NEPA) of 1969 (42 USC 4321, et seq.), which requires an environmental analysis for major Federal actions that may have the potential to impact the quality of the human environment;
- Council on Environmental Quality (CEQ) regulations in 40 Code of Federal Regulations (CFR) Parts 1500-1508, which implement the requirements of NEPA;
- Presidential Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*, which requires an environmental analysis for major actions conducted outside the United States (U.S.) to determine if there is a potential for significant environmental impacts; and
- Chief of Naval Operations Instruction (OPNAVINST) 5090.1B, which delineates the Navy's internal operational procedures on how to implement the provisions of NEPA and EO 12114.

The provisions of NEPA apply to major Federal actions that occur in the U.S. and within 22 kilometers (km) (12 nautical miles (nm)) from its shores. The provisions of EO 12114 apply to major Federal actions that occur beyond 22 km of the U.S., in the global commons, or within the jurisdiction of a non-participating foreign government. Both NEPA and EO 12114 apply to this Proposed Action because DT and OT will be conducted within and outside the U.S. territory. Therefore, a combination of an EA and an OEA has been prepared to address the potential environmental impacts from implementing the Proposed Action.

1.1 Background

The Navy currently has a need to streamline and consolidate the existing Navy helicopter weapon system force structure to meet present and future antisubmarine warfare (ASW), antisurface warfare (ASuW), and combat search and rescue (SAR) missions. The three Navy helicopters currently performing these missions are the SH-60B, SH-60F, and the HH-60H:

- SH-60B is an airborne platform-based helicopter aboard cruisers, destroyers, and frigates. The SH-60B's primary missions are ASW and ASuW, and the helicopter is an integrated weapon system for the Navy's surface combatant forces. The SH-60B deploys sonobuoys and torpedoes in an ASW mission and is also capable of firing missiles in combat SAR missions. Secondary missions supported by the SH-60B include electronic warfare and command, control, and communications.

- SH-60F is a carrier-based helicopter that includes dipping sonar (AN/AQS-13F) and sonobuoy processing systems used to detect and localize submarines in the water; however, it lacks a surface search radar system. The SH-60F's primary mission is ASW, but the helicopter also contributes to maritime interdiction and SAR operations.
- HH-60H is a carrier air wing helicopter and performs the mission of combat SAR and special operations warfare support. Executing missions from either air-capable ships or from ashore, the HH-60H is equipped with the Forward Looking Infrared Receiver/Laser Rangefinder Designator (FLIR/LRD) coupled with HELLFIRE missiles to respond to primary missions.

In addition to the need for streamlining Navy helicopters, the Navy has also identified an additional need to expand upon the war-fighting capabilities, as well as the detection and classification capabilities of the Navy's helicopter force structure. Current dipping sonar systems (i.e., AN/AQS-13F mid-frequency (MF) sonar transducer) that perform detection and classification of submarines also require improvement to meet the Navy's need for advanced ASW capabilities and new undersea warfare (USW) requirements.

As such, the Navy has identified the SH-60R with ALFS as the requisite systems that meet these needs and that provide a true multi-mission helicopter force. The SH-60R Program involves:

- The remanufacturing of the existing H-60 series helicopters,
- An improved common cockpit,
- Incorporation of the advanced Multi-Mode Radar (MMR) including the Inverse Synthetic Aperture Radar (ISAR),
- An enhanced avionics and computer suite,
- An improved Electronic Support Measures (ESM) Suite,
- Incorporation of the ALFS system,
- Integration of the nose FLIR/LRD system, and
- Integration of weapon systems (machine gun mounts and HELLFIRE or PENGUIN missile launchers).

1.2 Purpose and Need

The purpose of the Proposed Action, Navy DT and OT for the SH-60R and ALFS, is to demonstrate the capability and improved effectiveness in performing the missions currently satisfied by H-60 helicopters and the AN/AQS-13F dipping sonar. The SH-60R has been designated as the Navy's only platform for integrating and deploying the ALFS. It is one of the primary systems necessary for the SH-60R to perform ASW missions. ALFS is necessary to improve detection capabilities and counter more readily the current emerging USW threat (quieter and harder to find submarines in the littoral environment) posed by advanced designed submarine systems. The SH-60R/ALFS is designated to carry the Navy's tactical helicopter community through 2020.

The purpose of DT and OT are to assess the functional and operational suitability, capability, and effectiveness of the SH-60R, ALFS, and the other associated systems. Both DT, which addresses technical specifications and operating criteria, and OT, which evaluates aircraft operations applied to fleet activities, of the SH-60R is needed to verify the successful integration of the aforementioned upgrades and the performance of the systems. DT and OT are also needed to evaluate the overall safety and maintainability of the SH-60R and to identify and correct or minimize any hazards not foreseen by prior system safety design efforts.

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2. PROPOSED ACTION AND ALTERNATIVES

As indicated in Section 1, the purpose of the Proposed Action is to determine the functional and operational suitability, capability, and effectiveness of the SH-60R, ALFS, and the other associated systems. Implementation of the Proposed Action, DT and OT of the SH-60R and ALFS, is the Navy's Preferred Alternative. This section provides general descriptions of test equipment components, test mission and range requirements, the Proposed Action, and alternatives.

2.1 Equipment Description

2.1.1 SH-60R Description

The SH-60R helicopter is a single-rotor twin-engine aircraft powered by two 1,700 shaft horse power (SHP) T700-GE-401C turboshaft engines and cleared to 23,500 pounds (lbs) gross take off weight. The helicopter has the ability to deploy quickly from naval vessels such as carriers, cruisers, destroyers, and frigates. The aircraft carries a crew of three or four (two pilots, one sensor operator, and, on certain missions, a rescue swimmer) and can be configured for an array of weapons. The SH-60R is capable of ranging at least to 190 nm from its launch platform while conducting a variety of missions. It is used for ASW, ASuW, SAR, drug interdiction, cargo lift, and special operations. Through the use of computer data links to other surface ships, the SH-60R can expand radar and sonar ranges well beyond the visual horizon.

The SH-60R has a top speed of approximately 130 knots (kt) (150 miles per hour (mph)) and a flight endurance of about 2.5 hours (depending on configuration). Onboard equipment for locating and/or attacking submarines can include a chin-mounted 360-degree surface search radar, sonobuoy launcher, FLIR/LRD, dipping sonar (ALFS), and homing torpedoes. For ASuW and ASW missions, the SH-60R can carry the PENGUIN antisurface missile or the HELLFIRE laser guided missile.

The range of the aircraft will vary dramatically based primarily on the gross weight of the aircraft, the mission flight profile, air temperature, altitude, winds and other various factors. Depending on the configuration for the mission and the weight of the mission equipment, the amount of fuel burned per hour will change. Also, the heavier the equipment, the less fuel the helicopter can carry before reaching maximum gross weight. Some missions allow the test pilots to fly at maximum endurance airspeed for most of their on-station time, but other missions require maximum speed sprints and hovering. Hovering requires more power, and therefore more fuel consumption, than flying at any airspeed up to about 130 knots (kt).

Examples of different rates of fuel consumption and range are discussed below. The least fuel consuming tactical mission might be ASuW surveillance in which the helicopter is able to carry two auxiliary tanks and spend most of the flight profile at maximum endurance speed. In this case, the on-station time will need to be at least an hour. This allows 90 minutes for transit to and from the operating area and, at the maximum range airspeed for the given weight, permits a range of about 190 nm. A mission that would burn a lot of fuel would be ASW using dipping sonar in which the helicopter is only able to carry one auxiliary tank and is not able to fill it completely due to weight limitations. The mission profile would include sprinting and hovering. In this case, the on-station time would be about 90 minutes. This timeframe allows 40 minutes for transit to and from the operating area, and at a maximum range airspeed for the given weight, permits a range of about 85 nm.

2.1.2 Airborne Low Frequency Sonar (ALFS) Description

The SH-60R helicopter is equipped with the Navy's next generation helicopter dipping sonar, the ALFS (AN/AQS-22), which allows the helicopter to listen for and transmit underwater electronic signals while in a "hover" or stationary mode. The aircraft typically hovers at an altitude of 50 to 300 feet (ft) above sea level and lowers the transducer (as shown in Figures 2-1 and 2-2) into the water using a powered reel system similar to a fishing reel. The transducer can be lowered to depths ranging from the water's surface to 2,450 ft. Once lowered to the selected depth, the transducer is activated, generating sound signals and receiving echoes from submerged objects. These echoes can then be processed to identify and locate potential underwater threats.

Figure 2-1: ALFS Transducer

Historically, airborne dipping sonars have operated in the high-frequency range (10 - 100 kilohertz (kHz)), providing very high directional accuracy, but limited range due to sound absorption by the water. By operating in the lower MF range (1–10 kHz), ALFS is affected much less by absorption and can achieve greater detection ranges, while maintaining high directional accuracy. The physical and acoustic characteristics of the ALFS transducer are provided in Table 2-1.

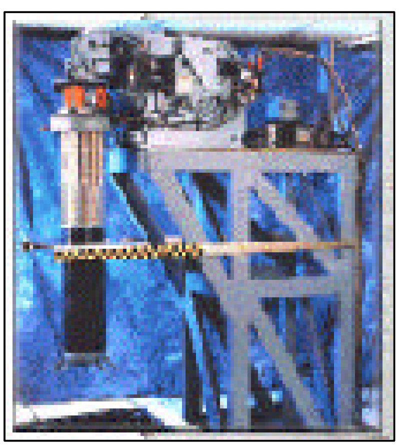

Figure 2-2: ALFS Undeployed Configuration

ALFS operates in the frequency band of 3-5 kHz, but the bandwidth of an individual pulse is less than 1 kHz. Pulse lengths are less than 10 seconds (s), and typically less than 1 s. The duty cycle is less than or equal to 10 percent, with a pulse repetition rate of 0.01-70 s. The maximum source level (SL) is less than 220 decibels (dB) referenced to (re) 1 microPascal (μPa) at 1-meter (m). In acoustics, decibels are relational units comparing the level of the sound of interest to a reference sound. In underwater acoustics, the sound pressure level of that reference is 1 μPa (measured at a distance of 1 m from the source). Thus, source levels for underwater sound are stated in terms of dB re 1 μPa at 1 m.

Table 2-1:
ALFS Characteristics

Physical Characteristics	
Length	1.27 meters (m) (50 inches (in))
Diameter	21 centimeters (cm) (8.3 in)
Receive Array	24 staves on 12 arms, hydraulic unfold, spring retraction, fold/unfold time < 5 s
Projector	Ceramic projector rings
Max operating depth	747 m (2450 ft)
Acoustic Characteristics	
Frequency Range	between 3 and 5 kHz*
Bandwidth	< 1 kHz
Pulse Length	< 10 s (normally ≤ 1 s)
Duty Cycle	≤ 10%
Pulse Repetition Interval	.01 – 70 s
Max Source Level *	< 220 dB re 1 μPa at 1 m

Notes: *For underwater acoustics, low frequency is generally described as < 1 kHz. Technically, ALFS operates in the mid-frequency band of 1-10 kHz.

2.1.3 AN/AQS-13F Sonar Description

To compare the performance of ALFS to that of existing dipping sonars, test planners intend to use the AN/AQS-13F sonar transducer on a limited number of missions. Like ALFS, the AN/AQS-13F transducer is lowered and raised on a reel from the SH-60F helicopter operating in a hover. Characteristics of the AN/AQS-13F transducer are provided in the Table 2-2.

Table 2-2:
AN/AQS-13F Characteristics

Weight	190 lbs
Dimensions	50 in tall, 11 in diameter
Frequency Range	9 – 11 kHz
Pulse Length	3.5 – 700 msec
Sound Pressure Level	216 dB (omnidirectional transducer)
Maximum Operating Depth	1,450 ft (442 m) at 50 ft (15.2 m) hover

(Watts, 1995)

2.1.4 Forward Looking Infrared Receiver/Laser Rangefinder Designator (FLIR/LRD) Description

The FLIR/LRD selected for use on the SH-60R aircraft is the AN/AAS-44. It is a light-weight, multipurpose, thermal-imaging system that can be used for navigation, surveillance, search-and-rescue, and laser ranging and designation to support the operation of the HELLFIRE missile system. The FLIR system consists of the the following components:

- Turret Unit (TU)
- Electronics Unit (EU)
- Hand Control Unit (HCU)
- Boresight Module (SM)

Incorprated into the FLIR/LRD is a 1.064 micrometer (μm) Neodymium Yttrium Aluminum Garnet (Nd:YAG), Flashlamp pumped, Q-switched laser. This laser is basically the same laser that is used on the Air Force F-117 aircraft for directing laser guided bombs. However, the laser in the SH-60R will be used to provide ranging and the designation of targets being fired upon by SH-60R designated missiles. The FLIR EU generates the symbology required for missile engagements and provides for mode selections using the HCU (U.S. DoN, 1997c).

2.1.5 Multi-Mode Radar (MMR) System Description

The MMR provides enhanced long-range and short-range search capability, a periscope detect capability, a targeting capability for the PENGUIN missile and third party targeting, a land mass contouring capability for navigation use, a weather detection capability, and a long-range ISAR imaging and classification capability.

The MMR has a high bandwidth coherent processing capability, which is required for the ISAR imaging function, and which is also used to achieve higher search radar resolution and additional jamming immunity. The high bandwidth coherent processing capability and advanced digital signal processing architecture will support growth modes of Pulse Doppler Missile Detection and Synthetic Aperture Radar.

2.1.6 Inverse Synthetic Aperture Radar (ISAR) Description

This radar function is used to create a two-dimensional image of a designated surface target for the purpose of identifying the ship class to which the target belongs. The imaging function can be performed from a sufficiently long range so that the ASW helicopter can remain beyond the threat radius of surface-to-air missiles carried by the target.

The ISAR image information will be transmitted by the MMR to the Master Computer, where it will be formatted for display to the operator. In addition to displaying the dynamic (real-time) ISAR image, the display formatting will also allow the operator to freeze images on the display screen as an aid in classifying the target. The frozen images can be displayed either in a full-screen format of a single image or in a split-screen (quadrant) format of up to four different images. One of the images in the quadrant format can be a dynamic image. This function will automatically compare the ISAR images to a limited ship library and will list probable ship classes along with a confidence factor.

2.1.7 Electronic Support Measures (ESM) Suite Description

ESM are a general classification of systems that use electromagnetic energy to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum. Depending on the type of system, they can be used to find, track, target, or monitor any number of ground, air, or naval targets.

2.1.8 Weapon and Detection Stores Description

The proposed SH-60R DT and OT requires the use of stores as part of system integration and verification on the helicopter performing its designated missions. A store is defined as any item capable of being released or expended from the SH-60R helicopter. For this Proposed Action, some of the stores contain energetic materials and/or produce active "pings" into the physical environment. Stores used for these tests are classified into the following broad categories: (1) missiles; (2) sonobuoys; and (3) decoys. Table 2-3 summarizes the types and quantities of stores proposed for SH-60R DT and OT. Appendix A provides a general description of the physical specifications and characteristics of each stores category.

Table 2-3:
Types and Quantities of Stores Proposed for SH-60R Test Program

Store Category	Store Type	Total Quantities*
Missiles	HELLFIRE	4
	PENGUIN	1
Sonobuoys	AN/SSQ-36	26
	AN/SSQ-53	135
	AN/SSQ-57	26
	AN/SSQ-62	70
	AN/SSQ-77	108
Decoys	MK-55 smoke	5
Marine Markers	MK-25 smoke	18
	MK-58 smoke	25
Support Targets	MK-30	TBD**
	MK-39	TBD**
	Radar targets	TBD**
	SEPTAR boats	TBD**
Chaff	RR-129	TBD**
	RR-144	TBD**
	RR-183	TBD**
Ammunition	50 caliber machine gun	2000 rounds
Flares	MK-46	TBD**

*Total quantities are approximations and are subject to variations depending on test requirements. **TBD = To be determined.

Both the PENGUIN and HELLFIRE missiles, for the purposes of SH-60R tests, will be comprised of an inert warhead and a "live" solid rocket motor, which provides the energy needed for the missiles to reach their targets. The PENGUIN missile is launched at a surface target acquired on the helicopter's radar. It is targeted using either the APS-147 Radio Detection and Ranging (RADAR) or the FLIR/LRD system. Once launched, it becomes a "fire-and-forget" weapon that automatically hones in on its target. Likewise, the HELLFIRE missile is launched at a surface target using the FLIR/LRD system.

The ASW mission requires the SH-60R crew to simulate and/or track submarines using sonobuoys. Sonobuoys are passive or active sonars that can localize a sound source. Sonobuoys are placed in patterns and provide the direction from which a sound is emanating underwater. The helicopter's crew can track and, if necessary, attack a submarine with torpedoes. Typical sonobuoys used by the Navy include Low Frequency and Ranging (LOFAR) and Directional Frequency and Ranging (DIFAR). Bathythermograph sonobuoys create a profile of water temperature versus depth. These sonobuoys may be launched during ALFS tests to compare its recordings with those obtained from using the ALFS sonar transducer as a sensor. The Directional Command Active Sonobuoy System (DICASS) sonobuoys are also proposed for these tests.

2.2 Test Mission and Range Requirements

Selection of the preferred locations for the Proposed Action is based on DT, OT, and range requirements. Every Department of Defense (DoD) weapon system is developed from an Operational Requirements Document. This document defines the technical and operational thresholds that must be met to accept the weapon system into the Navy inventory and the desirable objectives that the Navy would like the weapon system to meet. The range combinations selected for the Proposed Action must support specific criteria for the following key components of the proposed DT and OT tests:

- Testing of navigation systems,
- Testing of the MMR systems,
- Testing of the Integrated Self-Defense (ISD) systems,
- Testing of the ALFS system, and
- Testing of the ESM system.

Any selected range site must fit into the funding constraints already identified for the SH-60R Program. Costs for deploying support personnel and equipment for the SH-60R to a range site, as well as transit distances from the land station to the test site, must be minimized to reduce cost and maximize test data collection. In addition, ocean bottom topography and shallow/deep water locations are necessary to allow for flexible test planning and mission scenarios. Requirements and ranges considered for the above DT and OT components are described in the following subsections of this document.

2.2.1 Testing of Navigation Systems

The minimum range requirements for testing the navigation systems integrated into the SH-60R are:

- Provide instrumentation capability including beacon and laser retro-reflector and mounting for reflector, along with real-time recording of both beacon and laser track information for the SH-60R helicopter. The range must have laser tracking to verify radar altimeter and pressure-derived altitude accuracy. The range must also have the capability to Kalman filter the data post flight for verification of true airspeed, ground speed, and ground-track accuracy.
- Provide adequate facilities to support an aircraft test. Minimum facility requirements are: hangar facilities for aircraft maintenance, 400 Hertz (Hz) electrical power, electrical power carts, tow tractors and associated equipment, and air conditioned facilities for contractor, maintenance, and test personnel support.
- Provide environmental data gathering and reporting of current water conditions such as wave-height, sea state, and atmospheric conditions in support of tests.
- Provide two dedicated ultra-high frequency (UHF) voice communications frequencies.
- Provide weather monitoring and forecasting capabilities prior to flight test.
- Provide a location that includes both land (including wet grassy areas) and water (with various wave heights) testing capability for the radar altimeter testing, as per the Air Standard 70/21 Specification for Evaluation of the Accuracy and Performance of Radio (RADAR) Altimeters.

Viable ranges must meet the above requirements, as well as the site considerations of cost and transit distances. Highest consideration is given to ranges that support the radar and barometric altitude, true airspeed, ground speed, and ground track accuracy tests, while minimizing the total flight hours. Ranges under consideration are those that maximize testing capability and minimize cost. The ranges considered for meeting SH-60R navigational system tests include:

- Naval Air Station (NAS) Patuxent River Complex (PRC), Patuxent River, MD, and the Atlantic Warning Areas (AWA), which are in proximity and convenient to support tests and evaluations conducted at NAS PRC;
- Naval Air Warfare Center, Weapons Division (NAWCWD), China Lake, CA;
- Atlantic Undersea Test and Evaluation Center (AUTEC), Andros Island, Bahamas;
- Southern California Offshore Range (SCORE), San Diego, CA;
- Pacific Missile Range Facility (PMRF), Barking Sands, HI;
- Naval Undersea Warfare Center (NUWC) Keyport, WA; and
- Naval Surface Warfare Center (NSWC), Panama City, FL.

Table 2-4 summarizes the results of the screening to determine reasonable test alternative locations.

Table 2-4:
Range Test Requirement Comparison for Navigation Systems

Minimum Range Requirements	NAS PRC, Patuxent River, MD; and AWA	NAWCWD, China Lake, CA	AUTEC, Andros Island, Bahamas	SCORE, San Diego, CA	PMRF, Barking Sands, HI	NUWC, Keyport, WA	NSWC, Panama City, FL
Laser tracking capability	Y	Y	N	N	N	N	N
Adequate facilities to support an aircraft test detachment	Y	Y	Y	Y	Y	Y	Y
Provide location that includes both land (including wet, grassy areas) and water with varying wave heights	Y	N	Y	Y	Y	Y	Y
Capability to provide environmental data including sea state measurements and atmospheric conditions	Y	N	Y	Y	P	Y	P
Two dedicated UHF voice communications frequencies	Y	Y	Y	Y	Y	Y	Y
Weather monitoring and forecasting capabilities	Y	Y	Y	Y	Y	Y	Y
Regular and sufficiently clear weather to support tests	Y	Y	Y	Y	Y	P	Y
Proximity to NAS PRC	N/A	3-day Transit	1-day Transit	3-day Transit	Ferry Required	3-day Transit	1-day Transit
Estimated Detachment Cost ($K)	0	640	320	640	960	740	450

Y = Capability Present; N = Not present; P = Partially present; N/A = Not Applicable; $K = Dollars in Thousands

The seven test ranges above all meet some of the site requirements and have been considered for their ability to meet the test and evaluation range requirements. The optimal range combination that best meets the test and evaluation requirements and is the most cost efficient is NAS PRC and the AWA. This location is ideal to perform all stages of navigation systems testing, with superior aircraft facilities; locations including land with wet, grassy areas and water; laser capability; and no detachment cost. The fact that NAS PRC has an approved Environmental Impact Statement (EIS) in place for range tests and operations also makes the selection of this location ideal from an environmental viewpoint.

2.2.2 Testing of Multi-Mode Radar (MMR) Systems

The minimum range requirements for testing the MMR systems integrated into the SH-60R are:

- Provide instrumentation, which has the capability for simultaneous tracking of airborne and surface targets and the test aircraft. The range must be large enough to allow joint operations with Navy submarines and allow for tests of the MMR/SH-60R detection, localization, and tracking performance. These technical parameters are required to merge aircraft and surface contact positions for accuracy and system performance.
- Provide surface vessels, which can deploy and recover special radar targets and other test equipment required for data gathering. These technical parameters are necessary to deploy a Navy owned transponder for use in conjunction with the test system on the helicopter.
- Provide adequate facilities to support an aircraft test detachment. Minimum facility requirements are: hangar facilities for aircraft maintenance, 400 Hz electrical power, electrical power carts, tow tractors and associated equipment, and air conditioned facilities for contractor, maintenance, and test personnel support.
- Provide environmental data gathering and reporting of current water conditions such as wave-height, sea state, and atmospheric conditions in support of tests.
- Provide two dedicated UHF voice communications frequencies.
- Provide weather monitoring and forecasting capabilities prior to flight test. These capabilities are required to reduce safety concerns associated with the testing of new radar systems and assist with truth data to establish a system baseline.

Viable ranges must meet the above requirements, as well as the site considerations of cost and transit distances. Highest consideration is given to ranges that support the periscope detection tests while minimizing the total flight hours. Ranges under consideration are those which maximize testing capability and minimize cost. The ranges considered for meeting SH-60R MMR tests include:

- NAS PRC, Patuxent River, MD, and AWA;
- AUTEC, Andros Island, Bahamas;
- SCORE, San Diego, CA;
- PMRF, Barking Sands, HI;
- NUWC, Keyport, WA; and
- NSWC, Panama City, FL.

Table 2-5 summarizes the results of the screening to determine reasonable test alternative locations.

Table 2-5:
Range Test Requirement Comparison for MMR Systems

Minimum Range Requirements	NAS PRC, Patuxent River, MD; and AWA	AUTEC, Andros Island, Bahamas	SCORE, San Diego, CA	PMRF, Barking Sands, HI	NUWC, Keyport, WA	NSWC, Panama City, FL
Simultaneous tracking of surface contacts, surface vessels, and aircraft	Y	Y	Y	Y	Y	N
Surface vessels, which can deploy and recover large radar targets and other test equipment required for data gathering	Y	Y	Y	Y	Y	Y
Adequate facilities to support an aircraft test detachment	Y	Y	Y	Y	Y	Y
Capability to provide radar environmental data including sea state measurements and atmospheric conditions	Y	Y	Y	P	Y	P
Two dedicated UHF voice communications frequencies	Y	Y	Y	Y	Y	Y
Weather monitoring and forecasting capabilities	Y	Y	Y	Y	Y	Y
Regular and sufficiently clear weather to support Radar tests	Y	Y	Y	Y	P	Y
Dedicated area for periscope detection	N	Y	Y	Y	Y	N
Proximity to NAS PRC	N/A	1-day Transit	3-day Transit	Ferry Required	3-day Transit	1-day Transit
Estimated Detachment Cost ($K)	0	320	640	960	740	450

Y = Capability present; N = Not present; P = Partially present; N/A = Not Applicable; $K = Dollars in Thousands

The six test ranges above meet some of the site requirements and have been considered for their ability to meet the test and evaluation range requirements. The optimal range combination that best meets the test and evaluation requirements and is the most cost-efficient is NAS PRC, AWA, and AUTEC. With close proximity to shallow water, superior aircraft facilities, and minimal detachment cost, this range combination is ideal to perform the initial stages of testing. The MMR periscope detection tests will be conducted along with other tests already planned for the AUTEC range, provided the radar functionality and other subsystem testing are coincident. The NAS PRC site can meet all of the requirements but will require additional flight hours for transit to deep water in the AWA. The periscope detection flights conducted from NAS PRC will require a chase aircraft. Less than optimal, though adequate, the ship instrumentation is available to accomplish periscope detection testing at NAS PRC and AWA. The fact that NAS PRC and AUTEC already have approved NEPA/EO 12114 documentation in place for range tests and operations also makes the selection of these two ranges ideal from an environmental viewpoint.

2.2.3 Testing of Integrated Self-Defense (ISD) Systems

The minimum range requirements for testing the ISD systems for the SH-60R are:

- Provide instrumentation capability for aircraft tracking.
- Provide adequate facilities to support an aircraft test. Minimum facility requirements are: hangar facilities for aircraft maintenance, 400 Hz electrical power, electrical power carts, tow tractors and associated equipment, and air conditioned facilities for contractor, maintenance, and test personnel support.
- Provide environmental data gathering and reporting of current atmospheric conditions in support of tests.
- Provide two dedicated UHF voice communications frequencies.
- Provide weather monitoring and forecasting capabilities prior to flight test.
- Provide threat stimulation to include electronic warfare (EW), infrared, and laser threat signatures.
- Allow for countermeasure deployment to include chaff and flares.
- Provide range for aircraft lasing (Advanced Tactical Infrared Counter Measures (ATIRCM)).

Viable ranges must meet the above requirements, as well as site considerations of cost and transit distances. Highest consideration is given to ranges that support a full complement of actual and replicated sea- and land-based threat systems and that allow the deployment of chaff and flares. Ranges under consideration are those that maximize testing capability and minimize cost. The ranges considered for meeting SH-60R ISD system tests include:

- NAS PRC, Patuxent River, MD, and AWA;
- NAWCWD, China Lake, CA; and
- Marine Corps Air Station (MCAS) Cherry Point, NC.

Table 2-6 summarizes the results of the screening to determine reasonable test alternative locations.

Table 2-6:
Range Test Requirement Comparison for ISD Systems

Minimum Range Requirements	NAS PRC Patuxent River, MD; and AWA	NAWCWD China Lake, CA	MCAS Cherry Point, NC
Laser threat capability	P	Y	Y
Aircraft lasing	Y	Y	Y
Adequate facilities to support an aircraft test detachment	Y	Y	Y
EW and ifrared threat capability	P	Y	Y
Chaff and flare deployment	P	Y	Y
Capability to provide environmental data and atmospheric conditions	Y	N	Y
Two dedicated UHF voice communications frequencies	Y	Y	Y
Weather monitoring and forecasting capabilities	Y	Y	Y
Regular and sufficiently clear weather to support tests	Y	Y	Y
Proximity to NAS PRC	N/A	3-day Transit	1-day Transit
Estimated Detachment Cost ($K)	0	640	450

Y = Capability present; N = Not present; P = Partially present; N/A = Not Applicable; $K = Dollars in Thousands

All three of the test ranges above meet some of the site requirements and have been considered for their ability to meet the test and evaluation range requirements. The optimal range combination that best meets the test and evaluation requirements and is the most cost-efficient is MCAS Cherry Point. With superior aircraft facilities, ability to simulate EW and infrared threats, laser capability, and low detachment cost, this location is ideal to perform all stages of ISD system testing.

2.2.4 Testing of Airborne Low Frequency Sonar (ALFS) System

The minimum range requirements for testing the ALFS system integrated into the SH-60R are:

- Provide instrumentation that has the capability for the simultaneous tracking of underwater contacts, surface vessels, sonobuoys, and aircraft. The range must be large enough to allow joint operations with Navy submarines and allow for tests of the ALFS/SH-60R detection, localization, and tracking performance. These technical parameters are required to merge aircraft and subsurface contact positions for accuracy and system performance.

- Provide both a deep and shallow water tracking capability. The system under test must be able to perform its mission in shallow and deep-water environments.
- Provide surface vessels that can deploy and recover mines, transducer arrays, and other test equipment required for data gathering. These technical parameters are necessary to deploy a Navy owned transponder for use in conjunction with the test systems on the helicopter.
- Provide adequate facilities to support an aircraft test detachment. Minimum facility requirements are: hangar facilities for aircraft maintenance, 400 Hz electrical power, electrical power carts, tow tractors and associated equipment, and air conditioned facilities for contractor, maintenance, and test personnel support.
- Provide environmental data gathering and reporting of current water conditions, including Sound velocity profile (SVP), raytrace, wave-height, and ambient noise in support of tests.
- Provide two dedicated UHF voice communications frequencies.
- Provide weather monitoring and forecasting capabilities. Because of inherent safety issues with sonar testing, these capabilities are required to mitigate safety concerns.
- Provide regular and sufficiently clear and calm weather to support sonar tests.
- Provide fixed sonar transponder capable of triggering and responding to ALFS test frequencies.

Viable ranges must meet the above requirements, as well as site considerations of cost, transit distances, and ocean topography. Highest consideration is given to ranges that fit the maximum number of range requirements while minimizing the total number of detachments. Ranges under consideration are those that maximize testing capability and minimize cost. The ranges considered for meeting SH-60R and ALFS system tests include:

- NAS PRC, Patuxent River, MD, and AWA;
- AUTEC, Andros Island, Bahamas;
- SCORE, San Diego, CA;
- PMRF, Barking Sands, HI;
- NUWC, Keyport, WA;
- NSWC, Panama City, FL; and
- Ex-United States Ship (USS) *Salmon* site.

Table 2-7 summarizes the results of the screening to determine suitable test alternative locations. The seven test ranges all meet some of the site requirements and have been considered for their ability to meet the test and evaluation range requirements. The range combination that best meets the test and evaluation requirements and is the most cost-efficient is NAS PRC, AWA, the Ex-USS *Salmon* site, and AUTEC. With close proximity to shallow water, superior aircraft facilities, and minimal detachment cost, NAS PRC and the AWA are the ideal areas to perform the initial stages of testing. AUTEC can meet all of the test and evaluation requirements and has adequate facilities and close proximity to deep water. Detachment costs are minimized by using Navy facilities on Andros Island and by having only a one-day transit to the test site. The fact that this facility already has approved EO 12114 documentation for acoustical tests and operations in their range also makes the selection of AUTEC ideal from an environmental viewpoint. The Ex-USS *Salmon* site is a preferred location since it is a sunken submarine off the east coast in an established DoD range. This location provides test personnel with the option to use the ALFS against a stationary "target of opportunity" within close proximity to NAS PRC.

Table 2-7:
Range Test Requirement Comparison for ALFS System

Minimum Range Requirements	NAS PRC, Patuxent River, MD; and AWA	AUTEC, Andros Island, Bahamas	SCORE, San Diego, CA	PMRF, Barking Sands, HI	NUWC, Keyport, WA	Ex-USS *Salmon* Site	NSWC, Panama City, FL
Simultaneous tracking of underwater contacts, surface vessels, sonobuoys, and aircraft	N	Y	Y	Y	Y	N	N
Both a deep and shallow water tracking capability	N	Y	Y	N	N	N	N
Surface vessels that can deploy and recover mines, large transducer arrays, and other test equipment required for data gathering	N	Y	Y	Y	Y	N	Y
Adequate facilities to support an aircraft test detachment	Y	Y	Y	Y	Y	Y	Y
Capabilities to provide acoustic environmental data, including ambient noise measurements, sound velocity profiles, and raytraces real time	N	Y	Y	P	Y	N	N
Environmental data gathering and reporting of current water conditions	Y	Y	Y	Y	Y	N	Y
Two dedicated UHF voice communications frequencies	Y	Y	Y	Y	Y	N	Y
Weather monitoring and forecasting capabilities	Y	Y	Y	Y	Y	Y	Y
Regular and sufficiently clear and calm weather to support sonar tests	Y	Y	Y	Y	P	Y	Y
Fixed sonar transponder capable of triggering and responding to ALFS test frequencies	N	Y	N	N	Y	N	N
Proximity to deep water	N	Y	Y	Y	N	Y	Y
Proximity to shallow water	Y	N	Y	N	Y	Y	Y
Proximity to NAS PRC	N/A	1-day Transit	3-day Transit	Ferry Required	3-day Transit	1/2-day Transit	1-day Transit
Estimated detachment cost ($K)	0	320	640	960	740	5	450

Y = Capability Present; N = Not present; P = Partially present; N/A = Not applicable; $K = Dollars in Thousands

2.2.5 Testing of Electronic Support Measures (ESM) Systems

The minimum range requirements for testing the ESM systems integrated into the SH-60R are:

- Provide instrumentation capability for aircraft tracking.
- Provide adequate facilities to support an aircraft test. Minimum facility requirements are: hangar facilities for aircraft maintenance, 400 Hz electrical power, electrical power carts, tow tractors and associated equipment, and air conditioned facilities for contractor, maintenance, and test personnel support.
- Provide environmental data gathering and reporting of current atmospheric conditions in support of tests.
- Provide two dedicated UHF voice communications frequencies.
- Provide weather monitoring and forecasting capabilities prior to flight test.
- Provide EW threat stimulation.

Viable ranges must meet the above requirements, as well as site considerations of cost and transit distances. Highest consideration is given to ranges that support a full complement of actual and replicated sea- and land-based threat systems and that allow the deployment of chaff and flares. Ranges under consideration are those that maximize testing capability and minimize cost. The following ranges considered for meeting ESM system tests include:

- NAS PRC, Patuxent River, MD, and AWA;
- NAWCWD, China Lake, CA;
- MCAS Cherry Point, NC; and
- Poinsett Weapons Range, Shaw Air Force Base (AFB), SC.

Table 2-8 summarizes the results of the screening to determine reasonable test alternative locations. All of the four test ranges meet some of the site requirements and have been considered for their ability to meet the test and evaluation range requirements. The optimal range combination that best meets the test and evaluation requirements and is the most cost-efficient is NAS PRC and Poinsett Weapons Range, Shaw AFB, SC. Although less capable than NAS PRC, Poinsett Weapons Range at Shaw AFB provides a variety of emitters at a range cost of zero dollars and is best suited for basic ESM testing. NAS PRC provides an excellent number of threat emitters, but at a significantly larger range cost. NAS PRC is best suited for more advanced ESM testing.

Table 2-8:
Range Test Requirement Comparison for ESM Systems

Minimum Range Requirements	NAS PRC, Patuxent River, MD; and AWA	NAWCWD China Lake, CA	MCAS Cherry Point, NC	Poinsett Weapons Range, Shaw AFB, SC
Adequate facilities to support an aircraft test detachment	Y	Y	Y	Y
EW threat capability	P	Y	P	Y
Capability to provide environmental data and atmospheric conditions.	Y	N	Y	Y
Two dedicated UHF voice communications frequencies	Y	Y	Y	Y
Weather monitoring and forecasting capabilities	Y	Y	Y	Y
Regular and sufficiently clear weather to support tests	Y	Y	Y	Y
Allow the deployment of chaff and flares	Y	Y	Y	Y
Proximity to NAS PRC	N/A	3-day Transit	1-day Transit	1-day Transit
Estimated detachment and test cost ($K)	400	400	200	200

Y = Capability present; N = Not present; P = Partially present; N/A = Not Applicable; $K = Dollars in Thousands

2.3 Proposed Action

The Proposed Action is to conduct DT and OT of the SH-60R during fiscal year (FY) 99 to FY 01. DT involves the process of ensuring that technical specifications and operating criteria have been successfully designed and built into the systems. OT, on the other hand, is intended to verify all aspects of the aircraft from a fleet perspective. Testing will include an evaluation of new and upgraded systems (described in Section 2.1), including the ALFS, an improved ISAR, upgraded communications suite (very-high frequency (VHF) and UHF radios), new software programs, and Night Vision Goggle (NVG) compatibility.

Test flights for the ALFS will consist of flights from a shore station or ship location, transit to an operating area, and deployment of the ALFS transducer. The ALFS transducer will be lowered into water at depths ranging from the water's surface to 747 m (2,450 ft). Initial ping tests will be at a depth of 15.2 m (50 ft) to verify that the ALFS reeling mechanism and bottom sensor are functioning properly. These tests are of a short duration with only one or two pings. After verification testing in the Chesapeake Test Range (CTR), ALFS testing will occur at 61 m (200 ft) to 747 m (2,450 ft) depths. At this point, a typical test of the ALFS is to raise and lower the transducer for a three-hour period to evaluate the reeling mechanism and transducer operating capabilities. Other testing will involve pinging of the transducer for a three-hour period at a steady depth. When active, ALFS has a cycle time of approximately 10 percent. For every hour of operation, active pinging lasts for approximately six minutes. A typical operation consists of a 500-millisecond (500-msec) active pulse, followed by five or more seconds of listening, or passive operation.

Additional testing will determine capabilities of SH-60R electronics and software upgrades to effectively locate and track a participating submarine using DICASS sonobuoys, DIFAR sonobuoys, and the ALFS active transducer in both active (pinging) and passive (listening) modes. Following this testing, the SH-60R will test the new ISAR radar to determine its effectiveness for periscope detection, using a partially submerged submarine as a target.

Concurrent testing will occur to verify Identification Friend or Foe (IFF) calibration, verification of the Global Positioning System (GPS) accuracy, the operation of the UHF and VHF radios, software integration testing, and NVG compatibility. During DT and OT, there will also be a number of flights simulating every day mission profiles that the SH-60R could be called upon to perform. These flights will include land-based or ship-based takeoffs and landings, submarine search and localization, as well as radar tracking of exercise ships and other “targets of opportunity.”

It should be noted the number of planned flights and stores may vary slightly throughout the SH-60R/ALFS test period, but are not expected to deviate substantially. However, if substantial changes to the test program are planned, as described in Table 2-9 and therefore this document, then the SH-60R Program Office will coordinate accordingly with appropriate environmental representatives to determine if a supplement to this NEPA/EO 12114 document is required.

**Table 2-9:
Estimated Overview of DT and OT Elements**

Time Period	Total # of Flights	Total # of Flight Hours	Total # of Flight Hours at Altitude < 500’	% at Low Altitude	Stores/Expendables Type (Quantity)
1999	91	222	76.56	34	AN/SSQ-36 (2), AN/SSQ-53 (12), AN/SSQ-62 (21), AN/SSQ-77 (5), AN/SSQ-57 (30)
2000	156	386	130.81	34	AN/SSQ-36 (13), AN/SSQ-57 (13), AN/SSQ-53 (67), AN/SSQ-62 (49), AN/SSQ-77 (54), MK-25 (3), MK-55 (5), MK-58 (5)
2001	321	748	231.26	31	Chaff, flares, and machine gun ammunition, MK-25 (15), MK-58 (20) HELLFIRE (4), PENGUIN (1), AN/SSQ-36 (1), AN/SSQ-53 (2)
TOTAL	568	1356	438.63	32.3	

Note 1: The following support targets are used at different phases and locations for DT and OT: MK-30 and MK-39 targets, radar targets, and remotely controlled seaborne powered target (SEPTAR) boats.
Note 2: Chaff is RR-129, RR-144, and RR-183. Flares are MK-46. Ammunition is 50 caliber machine gun rounds that will be fired at Hannibal Target in the CTR at NAS PRC.
Note 3: Flight numbers, total hours, and quantity of stores are only estimates and are subject to change.

2.4 Alternatives

Four alternatives were considered for the Proposed Action: the Preferred Alternative, the Minimum Requirements Alternative, Computer Simulation and Modeling, and the No Action Alternative.

2.4.1 Preferred Alternative

The Preferred Alternative is to conduct SH-60R DT and OT at a combination of DoD established military facilities and ranges. Various tests sites have been considered and selection criteria (e.g., distance to test sites, technological capabilities, physical attributes of the test location, etc.) have been used by test engineers to determine if those sites could support test requirements (see Section 2.2). As a result of this site selection analysis, the Navy has determined the Preferred Alternative test locations (see Figure 2-3) are the most suitable existing ranges with the required facilities, equipment, qualified personnel, and range technical attributes available to conduct the full spectrum of required tests, evaluation events, and mission scenarios for the SH-60R/ALFS Test Program.

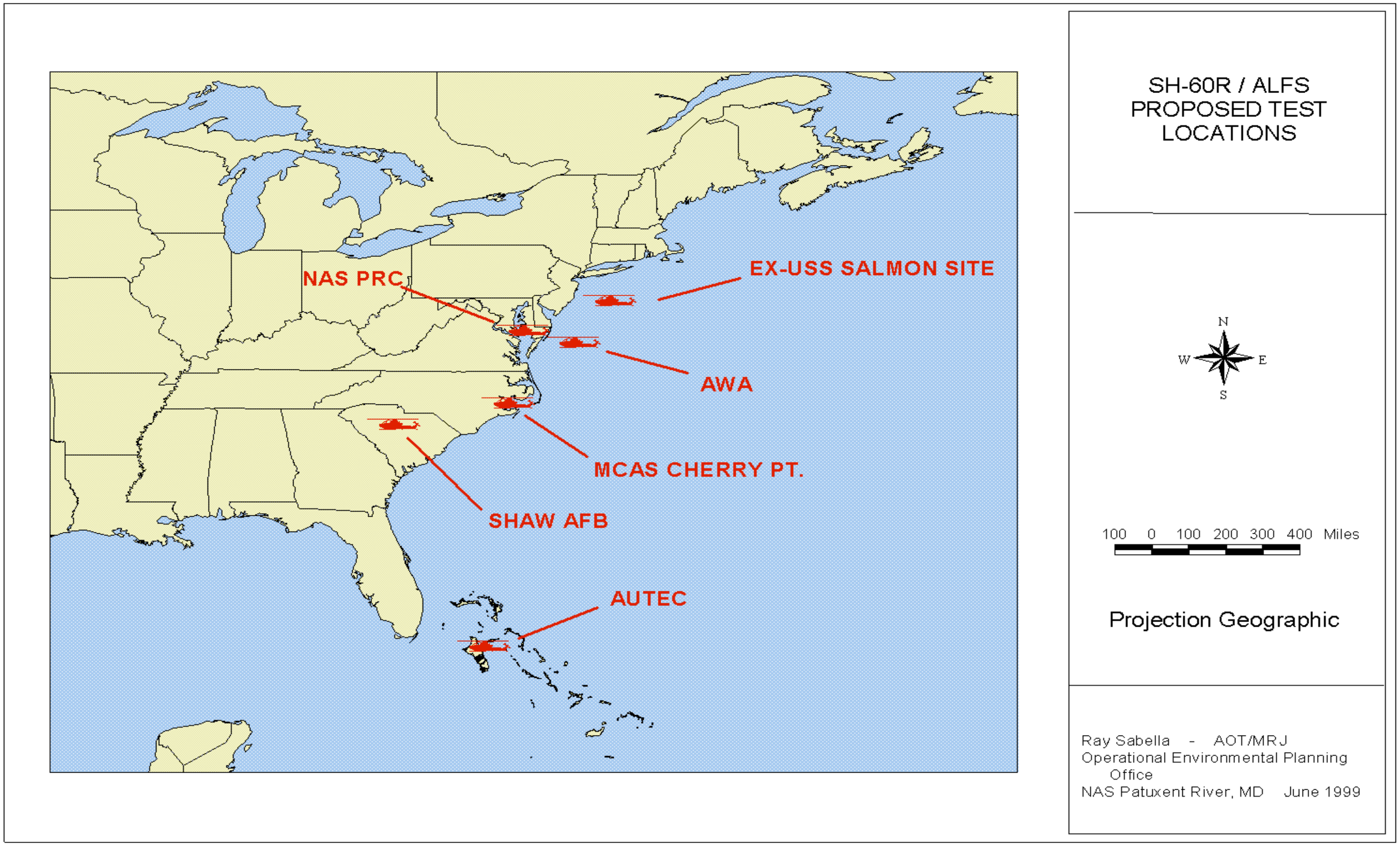

Figure 2-3:
Preferred Alternative Test Locations

The SH-60R Program has also found these preferred locations to be the most efficient use of DoD and Navy facilities and resources, thereby minimizing program schedule risks and greater costs. Table 2-10 provides a summary of proposed time periods and the general types of test events planned at each Preferred Alternative location.

Table 2-10:
Test Description Summary for Preferred Alternative Test Locations

Test Site Location	Time Period	Test Description
NAS PRC	1999	ALFS, MMR, IFF transponder, Navigation, Communications, Software, Mission Profiles, and Flight Avionics System
	2000	ALFS, MMR, IFF, Human Factors
	2001	E3, ISD/ESM, ALFS, MMR, IFF, Communications, Navigation, DI, Air Vehicle/NVG, Acoustics
AWA	1999	ALFS, MMR, Navigation
	2000	MMR, IFF, Navigation, ALFS
	2001	Missiles, ALFS, Navigation
Ex-USS *Salmon* site	1999-2000	ALFS
MCAS Cherry Point	2001	ISD, ESM
AUTEC	1999-2001	ALFS, MMR
Poinsett Weapons Range, Shaw AFB	2001	ESM

Notes: E3 = Electromagnetic environmental effects; DI = Dynamic interface.

NAS PRC and AWA are the primary test sites for the SH-60R, having both the necessary technical capabilities to support testing, as well as required physical attributes. AWA, Ex-USS *Salmon* site, and AUTEC are the primary testing locations for ALFS. NAS PRC, specifically the CTR, is also used to test the operational functionality of the ALFS system prior to the SH-60R transiting to the primary test locations. The Ex-USS *Salmon* site offers the Navy an opportunity to test the ASW capabilities of the SH-60R and ALFS against a bottomed diesel submarine within close proximity of the primary SH-60R test site. MCAS Cherry Point and Poinsett Weapons Range, Shaw AFB are ideal test locations primarily because of their electronic warfare testing and simulation of threat capabilities, within close proximity of NAS PRC. ALFS will not be used at MCAS Cherry Point or Poinsett Weapons Range, Shaw AFB.

Additional descriptions of the attributes (facilities, equipment, and range capabilities) at each Preferred Alternative test location are provided in Appendix B. Maps of these locations are also presented in Appendix B.

2.4.2 Minimum Requirements Alternative

The Minimum Requirements Alternative is to use a minimum combination of other possible ranges. No single range can satisfy all of the test requirements, nor can a different combination of selected ranges achieve the costs and transit criteria for the Proposed Action and Preferred Alternative locations. The test screening selection process indicated, for example, that ISD

System tests could be conducted at NAWCWD China Lake. However, (1) the longer transit time, (2) greater costs for deploying support personnel and equipment to the facility, and (3) the inability to provide appropriate environmental data and atmospheric conditions make this location unacceptable by limiting the ability to perform necessary criteria tests and providing less flexibility for Navy needs. Another possible minimum combination would be to conduct ESM System tests at NAS PRC, NAWCWD China Lake, and/or MCAS Cherry Point rather than Poinsett Weapons Range, Shaw AFB. However, the combination of these facilities still do not have equivalent threat emitter and simulator assets needed for the full spectrum of SH-60R ESM System tests. This alternative is not preferred because it also limits the ability of the Navy to adequately assess this component of the SH-60R Test Program, increases tests costs substantially, and minimizes the flexibility for Navy testing needs. The Minimum Requirements Alternative is not considered acceptable for the SH-60R/ALFS Test Program, therefore it will not be analyzed further.

2.4.3 Computer Simulation and Modeling

This technology can be used to infer system performance. The SH-60R and ALFS Programs have used, as much as feasible, computer imagery, simulation, and modeling as part of the systems engineering and design process. However, computer simulation and modeling is not sufficient to ensure the successful performance and safety of the SH-60R helicopter and its integrated systems. Testing is necessary and part of the Navy’s approval process for aircraft system production and release to the fleet. Computer Simulation and Modeling is not a preferred alternative because it limits the Navy’s ability to meet testing and mission requirements, as defined in the Operational Requirements Document for both the SH-60R and ALFS. Therefore, this alternative will not be analyzed further.

2.4.4 No Action Alternative

Under the No Action Alternative, testing would not occur on the SH-60R and its systems, including ALFS. There would be no verification of system integration or operational effectiveness. The No Action Alternative does not allow the Navy to adequately assess the capability of the SH-60R/ALFS to meet the mission needs for an improved helicopter force structure. This alternative is not considered acceptable because it does not provide adequate validation of the SH-60R and its integrated system designs to perform ASW, ASuW, USW, and other mission requirements. DT and OT are necessary to verify critical system technical and operational performance thresholds, which must be achieved to meet mission requirements. However, pursuant to NEPA, the No Action Alternative must be analyzed in comparison to the Proposed Action. Consideration of the No Action Alternative also provides a baseline of environmental data (the “as is” condition) for existing manmade and natural environmental parameters with which to compare and contrast the impacts of action alternatives.

3. ENVIRONMENTAL ANALYSIS

This section provides a comprehensive overview of the affected environment and environmental consequences at Proposed Action test locations. Based on data collected for each site, analyses have been conducted (1) to determine the specific impacts that will occur and (2) to assess significance levels. The structure of this section corresponds to the environmental resources/factors potentially affected—***Air Quality, Water Quality, Noise, Socioeconomics, Coastal Zone Management, Biological***—followed by the impact on these resources at specific sites. This section is further divided into subsections as follows:

- **Affected Environment**: This subsection describes the relevant aspects and current conditions of the resource being considered. The descriptions establish a baseline of the physical and biological environment against which the potential environmental impacts were assessed.
- **Environmental Consequences**: This subsection evaluates the potential for significant impacts to the environment resulting from implementation of the Proposed Action. A useful synonym for the term "impact" is "effect." Simply stated, the analysis of the potential environmental impacts of the Proposed Action identifies the "effects" that the action has upon various resources of the environment. Once impacts are identified, a determination is made regarding their "significance." Significance requires consideration of context and intensity of the impact, as defined by NEPA. Significance can vary with the setting of the Proposed Action and the resources affected. For example, the more resources affected individually or cumulatively, the more significant the impact is likely to be considered. Furthermore, the more widespread the effect of an impact, proceeding from local to global, the more likely the impact is significant. The intensity of an impact is measured by the magnitude (how large or noticeable is the change or disparity), frequency (what is the probability of the impact occurring and duration and rate of occurrence), potential for controversy or establishing a precedent, or potential for violating laws or regulations imposed to protect the environment. Adverse or potentially significant impacts could be mitigated through avoidance, minimization, remediation, reduction, or compensation.

The environmental baseline for the following resources/factors—***Geology and Soils, Land Use, Utilities, Transportation, Aircraft Operations and Safety, Cultural, and Environmental Justice***—are not analyzed in further detail because the impacts to these resources are expected to be low/negligible.

- **Geology and Soils**—the Proposed Action does not require the establishment of any new facilities or disturbance of the ground to perform DT and OT.
- **Land Use**—the Proposed Action does not change the use or designation of the land; all test locations are at established DoD installations having land-use related programs in effect to minimize potential environmental impacts.
- **Utilities**—the Proposed Action does not require changes to existing infrastructure or utilities; there is no requirement for the permanent transfer of test support personnel to any of the proposed locations; no unique materials are needed for the test and maintenance of the aircraft; and all hazardous and waste material procedures are adhered to during the tests.

- **Transportation—**relocation of personnel to test locations, other than NAS PRC, is transient, and transportation modes do not require upgrades or changes to accommodate the Proposed Action.
- **Aircraft Operations and Safety—**the Proposed Action must be conducted in compliance with established air, range, weapon, and other installation safety operating procedures at each test location; appropriate flight safety clearances are required prior to implementation of the Proposed Action; safety analyses and test plans are prepared prior to implementation of the Proposed Action; test flights are also conducted in accordance with all operational and safety procedures contained in the current Naval Air Training and Operating Procedures (NATOPs).
- **Cultural¾** established cultural resource management and protection programs (i.e., *Draft Integrated Cultural Resources Management Plan-Archeology for Marine Corps Air Station Cherry Point*) minimize the potential for adverse effects; flights conducted in the AWA will avoid known and chartered underwater cultural resources.
- **Environmental Justice—**the Proposed Action uses existing test facilities, test ranges, and operating patterns that have evolved to minimize impacts to safety, health, and general quality of life to human populations, especially minority and low-income populations.

The proposed SH-60R and ALFS tests at AUTEC are not analyzed further in this EA/OEA because they are similar in scope to the operations addressed in the EO 12114 documentation for AUTEC. The potential environmental impacts and any mitigation measures required at AUTEC are covered in the *Final Environmental Review for the Adoption of a Range Management Plan for the Atlantic Undersea Test and Evaluation Center (AUTEC), Andros Island, Bahamas, 1997.* AUTEC's *Operating Control Directive for Range Operations Environmental Mitigation Procedures, 1999,* further defines operational procedures while using AUTEC facilities and ranges.

Likewise, the potential environmental impacts for tests at Poinsett Weapons Range, Shaw AFB have not been analyzed in this section because the scope and extent of the test events planned for 2001 have not been sufficiently defined for the Proposed Action. Once details of the ESM System tests proposed for Poinsett Weapons Range, Shaw AFB have been completed, the SH-60R Program will supplement this EA/OEA to address potential environmental effects. **Finally, there are no environmental impacts associated with the No Action Alternative.**

3.1 Air Quality

Under the Clean Air Act (CAA), National Ambient Air Quality Standards (NAAQS) are established to protect public health and welfare by defining minimum acceptable levels of air quality to be achieved throughout the nation for criteria pollutants. Criteria pollutants and the corresponding NAAQS are found in Table 3-1.

Table 3-1:
National Ambient Air Quality Standards

Criteria Pollutant	Unit	Maximum	Average Time Period
O_3	ppm	0.12	1 h
CO	ppm ppm	9 35	8 h 1 h
SO_2	ppm ppm	0.03 0.14	AAM 24 h
NO_x	ppm	0.05	AAM
PM_{10}	$\mu g/m^3$ $\mu g/m^3$	150 50	24 h AAM
Pb	$\mu g/m^3$	1.5	Quarterly

O_3 = Ozone; CO = Carbon Monoxide; SO_2 = Sulfur Dioxide; NO_x = Nitrogen Oxides; PM_{10} = Particulate Matter 10 Microns or Less in Diameter; Pb = Lead; ppm = Parts Per Million; $\mu g/m^3$ = Micrograms Per Cubic Meter; h = Hour(s); and AAM = Annual Arithmetic Mean.

Areas that meet the NAAQS standard for a criteria pollutant are designated as "attainment." Areas where the criteria pollutant level exceeds the NAAQS are designated as "nonattainment." Nonattainment areas are subcategorized based on the severity of their pollution problem (marginal, moderate, serious, severe, and extreme). When insufficient data exist to determine an area's attainment status, the area is considered in attainment (and may be designated unclassifiable). Both mobile and stationary sources are accounted for in the attainment/nonattainment designation. The U.S. Environmental Protection Agency (EPA) specifies whether areas attain or do not meet NAAQS.

3.1.1 Affected Environment

The following discusses the existing air quality environment at each proposed test location.

3.1.1.1 NAS PRC

The NAS PRC is located in southern MD on the tip of a peninsula between the Chesapeake Bay and the Patuxent River and is inclusive of the CTR that encompasses most of the Chesapeake Bay. The climate of the NAS PRC is categorized as humid temperate, moderated by nearby water bodies. Table 3-2 provides a summary of climate and meteorological information for NAS PRC.

Table 3-2:
NAS PRC Climate and Meteorology

Weather Parameter	Annual Data
Max. Normal Daily Temp in Celsius (°C) (Fahrenheit (°F))	18.4 (65.0)
Min. Normal Daily Temp in °C (°F)	7.4 (45.2)
Average Monthly Temp in °C (°F)	13.8 (56.9)
Normal Precipitation in m (in)	1.09 (42.78)
Prevailing Wind Direction	West

Attainment status at NAS PRC is summarized as follows:

- **NAS PRC—**NAS PRC is located adjacent to Lexington Park in St. Mary's County, MD, which is classified as attainment or unclassifiable/attainment for all six criteria pollutants.
- **CTR—**The boundaries of the CTR overlie portions of southern MD, the Eastern Shore in MD, the Northern Neck of VA, and Sussex County, DE. All the counties lying within the footprint of the CTR, except Calvert County in MD and Sussex County in DE, are classified as attainment or unclassifiable/attainment for all six criteria pollutants. For ozone, Calvert County is classified as serious nonattainment and Sussex County is designated as marginal nonattainment.

Additional information regarding air quality for NAS PRC can be found in the *Final Environmental Impact Statement, Increased Flights and Related Operations in the Patuxent River Complex, Patuxent River, Maryland* (U.S. DoN, 1998f).

3.1.1.2 AWA

The AWA is located in the Atlantic Ocean off the coasts of DE, MD, and VA and borders all of the coastal counties in the states. The available working airspace covers over 90,600 km^2 (35,000 mi^2). It is generally a humid temperate area. The summary climate information in Table 3-3 is based on climate data from the National Aeronautics and Space Administration (NASA) Wallops Island Facility, Wallops Island, VA (U.S. DoN, 1997a).

Table 3-3:
AWA Climate and Meteorology

Weather Parameter	Annual Data
Max. Normal Daily Temp in °C (°F)	18 (64)
Min. Normal Daily Temp in °C (°F)	8.9 (48)
Average Monthly Temp in °C (°F)	13 (56)
Normal Precipitation in m (in)	0.93 (36.8)
Prevailing Wind Direction	South

The attainment status is not relevant because the operations occurring after transit and during testing will be no closer than five miles from the coast and therefore outside the three-mile coastal State boundaries.

3.1.1.3 Ex-USS Salmon Site

The Ex-USS *Salmon* site consists of a square approximately 20 nm (north-south) by 20 nm (east-west), centered approximately 60 nm east-southeast of New York City, off the coast of NJ. The proposed test site is located in water depths of approximately 122 m (400 ft). Climate in the northwestern Atlantic is controlled by the Icelandic Low and the Bermuda High. The dominant of these is seasonally dependent. Table 3-4 provides a summary of climate information for the Ex-USS *Salmon* site.

Table 3-4:
Ex-USS *Salmon* Site Climate and Meteorology

Weather Parameter	Annual Data
Max. Normal Daily Temp in °C (°F)	16.2 (61.1)
Min. Normal Daily Temp in °C (°F)	8.4 (47.1)
Average Monthly Temp in °C (°F)	9.2 (48.6)
Normal Precipitation in m (in)	1.04 (41.08)
Prevailing Wind Direction	Southwest

The attainment status is not relevant, as the test range is located at the very edge of the Continental Shelf and outside of the three-mile coastal State boundary. Emissions from the Proposed Action are not considered in the attainment/nonattainment status because the Proposed Action will be no closer than five miles from the coast.

3.1.1.4 MCAS Cherry Point

MCAS Cherry Point is located on the east coast of central NC. Table 3-5 provides a summary of climate information.

Table 3-5:
MCAS Cherry Point Climate and Meteorology

Weather Parameter	Annual Data
Max. Normal Daily Temp in °C (°F)	21.2 (70.1)
Min. Normal Daily Temp in °C (°F)	8.4 (47.1)
Average Monthly Temp in °C (°F)	14.4 (58.0)
Normal Precipitation in m (in)	1.35 (53)
Prevailing Wind Direction	West

The Southern Coastal Plain air quality control region, which includes the MCAS Cherry Point Operating Area, is in attainment for all criteria pollutants.

3.1.2 Air Quality Environmental Consequences

This section discusses the potential for exceeding air quality standards as a result of the SH-60R Test Program. The basic calculation for estimating emissions is to multiply the aircraft activity (i.e., total flight hours) by an emission factor (i.e., pounds of pollutant per engine per hour) and double the product to derive the total emissions from both engines. Estimating emissions includes:

- The key items in the DT and OT matrices for the air emission analysis: test location, period of testing, and number of flight hours. Within each test location, flight hours for each year are stated on a per year basis.
- The yearly number of flight hours is multiplied by the emission factors for this particular helicopter engine. Table 3-6 presents the emission factors for the T700-401C engines and relevant information.

Table 3-6:
Helicopter Emission Factors (lbs/h) [1]

Criteria Pollutant: [2]	NO_x	VOC	SO_2	CO	PM_{10} [3]
Per Engine	6.0	0.33	6.3	3.6	0.888
Per Helicopter	12.0	0.66	12.6	7.2	1.776

[1]. Memorandum from General Electric, Inc. May 29, 1997; Technical Report, SH-60B T700-GE-401C Engine Evaluation, M. Mulcahy and J. Petz, Naval air Test Center, Patuxent River, MD, 1990; and Technical Manual, Turboshaft Engine Models (T700-GE-401 and T700-GE-401C), A1-T700A-IPB-400.

[2] NO_x, Volatile Organic Compound (VOC), and SO_2 emission rates for the T700-GE-401C engine are at maximum power conditions, except for CO and PM_{10}, which are at idle. Assumes JP-5 fuel, with sulfur at the maximum allowable levels of 0.4 percent by weight. Assumes sea level operation at 89°F.

[3] PM_{10} emissions are calculated from emission levels taken from a similar engine. The T58-GE-16 is similar in burn rate to the T700-401C. Technical Manual, Intermediate Maintenance, Turboshaft Engine (Model T-58), NAVAIR 02B-105AHC-6-1.

Table 3-7 presents the calculated emission estimates for the SH-60R Test Program and are based on DT and OT flight data summary matrices and engine emission factors.

Table 3-7:
Emissions from SH-60R Test Program

Range	Year	Total Flight Hrs. Per Year	Total Emissions by Air Pollutant (in Pounds)				
			NO_x	VOC	SO_2	CO	PM_{10}
NAS PRC	1999	118	1,416	78	1,487	850	210
	2000	193	2,316	127	2,432	1,390	343
	2001	113	1,356	75	1,424	814	201
	2000-2001	45	540	30	567	324	80
Total	**-**	**469**	**5,628**	**310**	**5,910**	**3,378**	**834**
AWA	1999	74	888	49	932	533	131
	2000	75	900	50	945	540	133
	2001	45	540	30	567	324	80
Total	**-**	**194**	**2,328**	**129**	**2,444**	**1,397**	**344**
Ex-USS *Salmon* Site	1999	30	360	20	378	216	53
	2000-2001	15	180	10	189	108	27
Total	**-**	**45**	**540**	**30**	**567**	**324**	**80**
MCAS Cherry Point	2001	120	1,440	79	1,512	864	213
Total All Sites	**-**	**828**	**9,936**	**548**	**10,433**	**5,099**	**1,471**

Section 176(c) of the CAA and 40 CFR Part 51, Subpart W mandate that Federal agencies assure that their actions conform to or uphold a State's Implementation Plan (SIP). SIPs are strategies documented by states to reduce air quality violations and to attain the NAAQS. There are special circumstances, however, in which a Federal action is not required to undergo conformity. These circumstance are: it is grandfathered by the general conformity rules; it is exempted by the general conformity rules; it is presumed to conform by the responsible Federal agency; it is *de minimis* in terms of the emission caused; or it is already subject to transportation conformity. However, in order to be exempt, presumed to conform, or *de minimis*, the action must not be regionally significant (i.e., greater than 10 percent of the emissions of a pollutant in a nonattainment or maintenance area). The Draft Chief of Naval Operations Interim Guidance on Compliance with the CAA General Conformity Rule outlines a step-by-step process for determining applicability of this requirement to a Proposed Action.

A review of the yearly totals, illustrated in Table 3-7, reveals that *de minimis* levels (100 tons per year (tpy) or less for each pollutant in order to qualify for *de minimis*) are not exceeded at any site, for any pollutant, for any year. The term *de minimis* means "so small as to be negligible or insignificant." Therefore, according to U.S. EPA general guidance for conducting a regional emissions inventory, emissions from the Proposed Action are not significant sources (U.S. EPA, 1991). Emissions for AWA and Ex-USS *Salmon* site are not analyzed further because tests are conducted outside the three-mile coastal State boundary. Drift from these two locations to State boundaries is not a factor. If the emissions were to disperse over a large area outside the test operating area, they would not result in a change to the State emission status or cause a problem. In addition, air pollutants are temporary in nature and quickly dissipate in a three dimensional manner following normal plume dispersion dynamics. Likewise, emissions for MCAS Cherry Point are not analyzed further because the area is in attainment for all criteria pollutants and SH-60R emission levels are well below *de minimis* levels.

Currently, all Federal agencies are subjected to conformity determination if their actions will impact areas that are in nonattainment or maintenance for the criteria pollutants. The primary air emissions concern is at NAS PRC, specifically two areas within the CTR. Both Calvert County, MD and Sussex County, DE are in nonattainment for ozone, and therefore further analysis is necessary to assess potential effects to air quality in the CTR. Ozone is an indirect, secondary pollutant that is converted from other primary emissions through an indirect process driven by sunlight and temperature. VOC (coming from mostly stationary sources) and NO_x (produced mainly from mobile sources) are converted to make ozone. Since ozone is not a primary pollutant and it is very difficult to calculate without modeling, the amount of ozone is expected to be at or below the emission levels for VOC and NO_x.

The projected SH-60R actions at NAS PRC have a minor impact on emissions at NAS PRC. Emissions resulting from the Proposed Action are below the applicable emission rates for nonattainment areas (see Appendix C). Therefore, the Proposed Action at NAS PRC has been determined to have no significant impact and does not trigger a conformity analysis required under the regulations in 40 CFR Part 51 Subpart W. A Record of Non-Applicability (RONA) for tests conducted at NAS PRC has been prepared and is provided in Appendix C.

3.2 Water Quality

Water resources are considered ground and surface waters and their physical, chemical, and biological characteristics. Water quality is regulated by the Clean Water Act of 1977 and is measured for physical parameters to characterize and determine potential impacts to water resources. Temperature, dissolved oxygen, salinity, and acidity/alkalinity (pH) are the most commonly measured physical parameters for aquatic systems.

- Temperature can vary through a water column, with the colder water usually staying at the bottom. Also, the water may often be stratified, with the less dense, warmer water floating above the denser cold water.
- The biological environment is affected by temperature due to the fact that a majority of organisms cannot regulate their internal body temperature. Often their metabolism is temperature regulated, which is another factor in global species diversity and location.
- Dissolved oxygen is a measurement of available oxygen in the water, usually reported in milligrams per liter (mg/L). Dissolved oxygen is also influenced by temperature, with colder water being able to hold more oxygen than warmer water. Just like the terrestrial environment, the aquatic environment is extremely oxygen dependent. Anoxic conditions are usually very costly for all living things, especially sedentary creatures like oysters, mussels, and corals.
- Salinity, in a body of water, is the measure of salt which is usually reported as parts per thousand (ppt). Salinities typically vary from 0 ppt (fresh water) to 36 ppt (ocean water), with estuaries and tidal rivers falling somewhere in between. The biological community is affected greatly by salinity, with regulation of osmotic pressure (osmoregulation) being a continuing problem for all aquatic organisms.
- pH is the negative log of hydronium ions in the water and describes the water in terms of acidity (values from 0-7), or alkalinity (values from 7-14). Most organisms prefer to live in the pH range of 6 to 8. Generally, pH does not play a part in biological activity in marine systems because seawater is so well buffered, and thus pH remains relatively constant throughout the year.

3.2.1 Affected Environment

The following discusses the existing water quality environment at each proposed test location.

3.2.1.1 NAS PRC

NAS PRC lies entirely within the Patuxent River and Chesapeake Bay, the largest and most productive estuary in the U.S., measuring 314 km (195 mi) long and 6,500 km^2 (2,500 mi^2) in area. Water depths in the range vary from 0 m to 50 m (0 ft to 164 ft).

Water circulation is typically a two-layer flow influenced by winds, tides, temperature changes, and rainfall. The U.S.EPA Chesapeake Bay Program has designated NAS PRC as Segment CB5, the central portion of the main stem of the Chesapeake Bay. This segment receives flow from the Potomac, Patuxent, and Nanticoke Rivers, as well as the Tangier and Pocomoke Sounds. Water quality in this segment is high in nutrients and generally classified as “good” by the Maryland Department of Natural Resources (MDNR) and the Maryland Department of the Environment (MDE). Water quality data are available from two monitoring stations close to CTR target areas and are provided in Table 3-8.

Table 3-8:
Average Monthly Water Quality Data for NAS PRC

Water Quality Parameter	CB5.1	CB5.2
Salinity (ppt)	14.6-21.13	14.4-21.13
Temperature in ºC (ºF)	3-26 (37-79)	3-26 (37-79)
Dissolved Oxygen (mg/L)	1.3-11.5	1.5-13
pH	7.6-8.2	7.5-8.4

Note: Monthly data were extracted from the Chesapeake Bay Program website from 1998 (see http://cobia.chesapeakebay.net/water_quality/station_main.cfm).

Dissolved oxygen concentrations can reach anoxic levels during the mid-summer to fall months at depths below 10 m (32.8 ft), when the process of decomposition of organic materials deposited in bottom sediments depletes free oxygen in the water column. Chesapeake Bay waters are typically neutral to slightly alkaline, with pH levels ranging from 7 to 8, which provide buffering capacity for small quantities of acidic compounds (e.g., hydrogen chloride) that may be released to the atmosphere in exhaust emissions and fall to the water’s surface.

Additional information regarding water quality for NAS PRC can be found in the *Final Environmental Impact Statement, Increased Flights and Related Operations in the Patuxent River Complex, Patuxent River, Maryland* (U.S. DoN, 1998f).

3.2.1.2 AWA

Under the control of the Fleet Area Control and Surveillance Facility (FACSFAC) Virginia Capes (VACAPES), the AWA includes areas in the offshore mid-Atlantic Ocean, extending from the DE coast to the southern VA coast. Water depths range from 0 m to roughly 4,000 m (2.5 mi). At its western boundary, depths in the AWA vary from 20 m (65.6 ft) to roughly 4,000 m (2.5 nm), while at its easternmost point depths are approximately 105 km (65 nm) offshore at the edge of the Continental Shelf.

Flow in the AWA can be characterized by a two-layer circulation model in which surface currents are pushed seaward by westerly winds and bottom currents move shoreward to replace surface flow. This is especially prevalent at the mouth of the Chesapeake Bay, where bottom currents move sediment towards the mouth. Water quality data for the AWA are provided in Table 3-9.

Table 3-9:
Average Monthly Water Quality Data for AWA

Water Quality Parameter	Station 1
Salinity (ppt)	33-36
Temperature in ºC (ºF)	11.6-25.3 (52.9-77.5)
Dissolved Oxygen (mg/L)	0.01-7.1
pH	7.5-8.5

3.2.1.3 Ex-USS Salmon Site

The Ex-USS *Salmon* site consists of a square approximately 36.6 km (20 nm) (north-south) by 36.6 km (20 nm) (east-west), centered at approximately 60 nm east-southeast of New York City off the coast of NJ. The proposed test site is located in water depths of approximately 122 m (400 ft). Currents at the site are controlled by the Slope Sea Gyre, and generally flow in a southeastern direction at 0.1 kt. Current magnitude is controlled by wind velocity and the Gulf Stream position (U.S. DoN, 1997d). Average water quality data for the Ex-USS *Salmon* site are provided in Table 3-10.

Table 3-10:
Average Monthly Water Quality Data for Ex-USS *Salmon* Site

Water Quality Parameter	Station 1
Salinity (ppt)	35
Temperature in °C (°F)	19.7 (67.5)
Dissolved Oxygen (mg/L)	5.5-6.0
pH	7.8

3.2.1.4 MCAS Cherry Point

MCAS Cherry Point Operating Area is located at the confluence of the Neuse River watershed and the Pamlico Sound. The Neuse River watershed extends from Persons and Orange Counties in north central NC to Pamlico Sound, and consists of approximately 5,310 km (3,300 mi) of rivers and streams. The air station is bordered on three sides by surface water bodies: the Neuse River to the north, Slocum and Tucker creeks to the West, and Hancock creek to the East. Areas of MCAS Cherry Point falling within the 100-year floodplain generally extend inland from these water bodies. No significant areas of the developed portion of the station, including the entire core area, are located within the 100-year floodplain (U.S. DoN, 1998d). Water quality data for MCAS Cherry Point are provided in Table 3-11.

**Table 3-11:
Average Monthly Water Quality Data for
MCAS Cherry Point**

Water Quality Parameter	Neuse River Stations
Salinity (ppt)	1.0-13.5
Temperature in ºC (ºF)	7.0-27.3 (44.6-81.1)
Dissolved Oxygen (mg/L)	5.2-12.6
pH	6.2-8.1

3.2.2 Water Quality Environmental Consequences

No adverse impacts are anticipated to water quality resulting from SH-60R test flights. Normal aircraft flights are not expected to disturb surface waters at any of the proposed test locations. The only potential impact would be in the event of an aircraft mishap resulting in the release of fuels or hydraulic fluids. The magnitude and duration of the spill would be controlled through established rescue and spill response procedures.

Not all the stores proposed for the SH-60R tests are recovered, and as such, have the potential to affect water quality. Studies and analyses have been conducted and discussed in other NEPA documentation regarding the potential water quality impacts from similar related actions. For example, the potential for adversely impacting water quality from corrosion of unrecovered stores was examined in the *Environmental Assessment for F/A-18E/F Stores Separation Testing* (U.S. DoN, 1997a). Unrecovered stores would settle to the bottom of surrounding waters and would corrode over time. The extent of water quality changes depends on released store corrosion rates; which, in turn, are affected by the salinity, temperature, dissolved oxygen, and pH of the surrounding waters. Given these factors, very small increases in metal concentrations (such as iron, aluminum, copper, zinc, magnesium, nickel, lead, etc.) would occur in the water. Overall, bay and ocean currents would dilute and disperse these small increases in metal ions. It was further determined combustion products and emissions from flares and the solid rocket motors of missiles would be dispersed in the atmosphere before reaching the water surface and was not expected to affect water quality. It was therefore concluded no adverse impacts to water quality in the Chesapeake Bay and Atlantic Ocean would occur from the release of stores.

Likewise, the *Final Environmental Impact Statement for Increased Flight and Related Operations in the Patuxent River Complex, Patuxent River, Maryland* (U.S. DoN, 1998f) examined the potential effects to water quality from released stores (e.g., missiles, gun ammunition, flares, bombs, etc.). The analysis concluded the small elevation of metal concentrations in the water from corroding stores, red phosphorous and titanium tetrachloride residues from spotting charges, and powdered magnesium and other trace compounds in flares would be restricted to a small zone around the released store(s) and would be quickly diluted by the Bay currents. A such, metal and chemical contaminants would not significantly accumulate and impact water quality. The EIS further examined the potential impacts from lead, the single largest component in small arms ammunition. Based on research studies regarding lead, it was determined the continued use of small arms ammunition at CTR targets would not adversely impact water quality since the release of lead in the overlying water column would occur in very small concentrations that are diluted rapidly.

The stores planned for the SH-60R Test Program are similar to those analyzed in the NEPA documents discussed in the above paragraphs. Using those documents as a baseline for assessing potential water quality effects, Table 3-12 summarizes the primary composition of stores categories planned for the SH-60R Test Program and provides an overall assessment on the potential effects. The impacts are not expected to be significant because (1) stores will be released at sporadic, various intervals during the three-year test period in a wide geographic area (as opposed to one designated area within a test location); and (2) metal and chemical constituents are concentrated in the immediate vicinity of corroding stores and are quickly diluted by water currents. Therefore, no adverse impact to water quality is expected from the use of stores in established military ranges and training areas.

Debris associated with plywood surface targets used in missile firings will be scattered about the target boat and into the surrounding waters. Prior to departing the test area, test personnel usually recover large floating debris (plywood). Smaller pieces of debris not recovered will biodegrade over time and will not pose a threat to water quality. Therefore, the individual and cumulative water quality impacts are not expected to be significant as a result of the Proposed Action.

Table 3-12:
Water Quality Assessment of Stores Released from the Proposed SH-60R Tests

Instruments	Water Quality Assessment
Sonobuoys	**Primary Waste Materials:** ***Metal Parts:*** Steel or aluminum and will slowly degrade over time. Small concentrations of metal ions will be diluted and dispersed by water currents. ***Plastic Parts***: These parts are attached to high density components and will sink to the ocean bottom floor after service life. Sonobuoys are released in wide pattern areas, so scuttled sonobuoys will not be in just one concentrated area within the test location. ***Electronic Components:*** These components include seawater-activated batteries, which contain sulfur dioxide, carbon monofluoride, and manganese dioxide; these are expended during their normal service life and will not present a significant impact to the environment.
ALFS Transducer (lowered & retrieved via an attached cable)	**Source and Array Materials:** The two helicopter dipping sonars, ALFS and the AN/AQS-13F, are all basically acoustic transducers, which are encased in either a cork-neoprene boot or a rubber/plastic coating. The ALFS transducer contains limited quantities of lubricants and hydraulic fluids (less than one liter) which are completely enclosed in the system, resulting in no releases to the environment under normal use. The entire array external to the helicopter, including the cable that is used to lower and raise the sonar transducers, is designed for exposure to the ocean environment. They are composed of inert materials (plastic, metal, and composites) and electronics that are shielded from the marine environment and will not introduce toxins or other hazardous materials into the environment.
Missiles	**Solid Rocket Motors:** The motors are comprised of propellant materials that burn quickly after launch from the helicopter. Small quantities of dispersed hydrogen chloride may be released in the exhaust emissions, but are quickly dispersed and are not expected to affect water quality because most of the propellant is burnt off prior to impacting the target and very little residue is left. The missile may or may not break up upon impact with the water and will sink to the bottom of the ocean either intact or in large metal pieces (steel composition). Small concentrations of metal ions in the immediate vicinity of corroding missiles will be diluted and dispersed by water currents.

Table 3-12 (continued): Water Quality Assessment of Stores Released from the Proposed SH-60R Tests

Instruments	Water Quality Assessment
Decoys	**Chaff:** Chaff consists of aluminum foil and aluminum-coated fiberglass products that remain in the environment for prolonged periods. The aluminum foil chaff also consists of a nitrocellulose type lacquer coating. The environmental effects will be negligible because chaff has been determined to be non-toxic to aquatic animals even when consumed in large quantities. Plastic holders for the chaff are usually constructed of a fragile (easily broken) material and are of sufficient size that they do not pose an ingestion hazard for sea turtles or marine mammals. Studies have been conducted to determine the effects of chaff. *Effects of Aluminized Fiberglass on Representative Chesapeake Bay Organisms (1977)* and *Aquatic Toxicity and Fate of Nickel Coated Graphite Fibers, with Comparisons to Iron and Aluminum Coated Glass Fibers (1993)* both address research that analyzed chaff. This research indicated aluminized fiberglass chaff has a minimal impact to the environment. Also, a report prepared for the Naval Research Laboratory in 1995 (in response to a previous report entitled *Exclusive Report; Chaff Potentially Harmful to the Environment, Studies Say* published in Electronic Warfare Digest, Vol. 17 No.4, April 1994) analyzed and concluded that chaff coating is not a problem, concentrations can be calculated, it is not toxic, and that it is not harmful to aquatic organisms. **Flares:** Flares are composed of powdered combustible material (typically powdered magnesium), a binder, and a trace of other compounds required for ignition and control of flare burning dynamics. Properly functioning flares burn for only a short time (less than ten seconds), with only incidental debris from the packaging remaining. Combustion products of flares are expected to disperse in the atmosphere before reaching the water's surface. The occasional addition of small amounts of magnesium and cardboard packaging is unlikely to cause an adverse impact. Magnesium is a naturally-occurring, widespread element in surface waters. Relatively few flares are expected to fail; however those that do fail are expected to settle to the bay or ocean floor, are expected to dissolve, and chemical constituents become quickly diluted. Therefore, no negative impacts to water quality impacts are expected from flares that fail to ignite on ejection.

3.3 Noise

Noise disturbances can occur in the air, the water, and the land. This section will address airborne noise, its characteristics, and applicable regulations. Discussion of underwater sound can be found in Section 3.6. A brief tutorial on sound follows, however a reader unfamiliar with sound should consult the appropriate texts (e.g., Kinsler et al., 1982; Urick, 1983; Richardson et al., 1995).

Characteristics of sound include parameters such as amplitude, frequency, and duration. Measurement of sound involves the basic physical characteristics of frequency and intensity. Sound frequency refers to the number of times per second the medium vibrates or oscillates as a result of sound pressure received from the source. Low frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches. Intensity is the amount of acoustic energy per second (power) crossing a unit area. The higher the sound pressure, the more energy carried by the sound and the louder the sound.

A dB is the unit commonly used to describe sound levels. A decibel is truly a ratio of acoustic intensities, and therefore a reference sound wave should be noted. For in-air sounds, the accepted reference is 20 μPa at 1 m. Airborne noise measurements are often expressed as broadband A-weighted sound levels, expressed in dB(A). A-weighted refers to frequency-dependent weighting factors applied to the sound in accordance with the sensitivity of the human ear to different frequencies. With A-weighting, sound energy at frequencies below 1 kHz and above 6 kHz is de-emphasized. To determine the sound level in dB(A), sound power in the A-weighted spectrum is integrated over frequency (Richardson et al., 1995). The dB(A) data are meaningful when assessing the potential effects of airborne noise on humans.

Community noise guidelines call for noise to be averaged over a 24-hour period, designated the day-night noise level (L_{dn}). There is no agreement about “acceptable” L_{dn} levels, but the usual range is 55 to 65 L_{dn}. Consequently, sound is interpreted as pleasant or unpleasant depending on current activity, noise level and frequency, experience, and attitude of the receptor with regard to the sound received from the source. Table 3-13 describes the dB(A) of common sounds.

Table 3-13:
A-Weighted Sound Levels of Common Sounds

Noise Level dB(A)	Common Noise Levels:	
	Indoor	**Outdoor**
110-120	Discotheque, rock-n-roll band	
100-110	New York subway	Jet flyover at 300 m (900 ft)
90-100	Cockpit of light aircraft	Gas lawnmower at 1 m (3 ft)
80-90	Garbage disposal at 1 m (3 ft), food blender at 1 m (3 ft)	Motorcycle at 15 m (45 ft) Noisy urban daytime
70-80	Shouting at 1 m (3 ft), clothes washer, television audio	Gas lawnmower at 30 m (90 ft)
60-70	Normal speech at 1 m (3 ft), vacuum cleaner at 3 m (9 ft), air conditioner at 6 m (18 ft)	Commercial area heavy traffic at 100 m (330 ft)
50-60	Large business office, dishwasher in the next room, light traffic at 30 m (100 ft)	
40-50	Small theater Large conference room	Quiet urban nighttime
30-40	Library	Quiet suburban nighttime
20-30	Bedroom at night, wilderness area	Quiet rural nighttime
10-20	Broadcast and recording studio	
0-10	Threshold of hearing	

(Modified from Kinsler, L. E. et al., 1982)

Consequently, certain land uses, facilities, and the people associated with them are more sensitive to a given level of noise than other uses. Such “sensitive receptors” include schools, churches, hospitals, retirement homes, campgrounds, wilderness areas, hiking trails, and some threatened and endangered biological (animal) species. Sensitivity of biological resources to sound intensity and frequency is the subject of numerous independent research programs. There is some evidence that noise due to human activities can impact the activities and habitats of birds.

Potential noise effects are associated with the SH-60R flights and mission scenarios proposed during DT and OT. Helicopters of different sizes and types emit intense low frequency engine sounds during flights. Most frequencies are in the range of 20 to 200 Hz, well within the range of hearing of most terrestrial and marine animals. Sound levels associated with the SH-60R are similar to the current H-60 helicopters, since the engines are the same.

3.3.1 Affected Environment

The following discusses the existing noise environment at each proposed test location.

3.3.1.1 NAS PRC

Noise is generated by the conduct of aircraft activities at NAS PRC. Noise levels generated by these activities vary depending upon the type of test or operation, the type of aircraft, and the location of the test or operation. The following factors are considered when assessing noise: airfield flight operations, runway and approach/departure utilization, aircraft flight profiles, climatological data, and pre-flight and maintenance runup operations. The models calculate and plot noise contours and exposure levels. Results of the noise analysis conducted in support of the EIS regarding NAS PRC found the 85 + dB(A) contour did not extend beyond the property line. Additional information concerning the existing noise environment at NAS PRC is addressed in the *Final Environmental Impact Statement for Increased Flight and Related Operations in the Patuxent River Complex, Patuxent River, Maryland* (U.S. DoN, 1998f).

3.3.1.2 AWA

Noise sources that add to the ambient sounds associated with an ocean environment include aircraft and human activity (commercial shipping, recreational boating, and/or commercial and recreational fishing). Sound levels vary and are highly dependent on the extent of human activity in this expansive military range and operating areas.

3.3.1.3 Ex-USS Salmon Site

Besides the ambient noise already present in the area, airborne acoustic noise is generated by aircraft and human activity (recreational boating, commercial shipping, and/or commercial and recreational fishing). Sound levels vary and are highly dependent on the extent of human activity at this military operating range.

3.3.1.4 MCAS Cherry Point

The main source of man-made noise at the MCAS Cherry Point operating area is aircraft operations such as takeoffs, landings, and touch-and-go exercises. Noise levels at the test ranges are due primarily to aircraft operations and weapons deployment. There are no noise-sensitive receptors in close proximity to the test ranges (U.S. DoN, 1998d).

3.3.2 Noise Environmental Consequences

This section addresses the potential effects from noise in the air and land environment resulting from SH-60 test flights. Effects to marine species from low flying helicopters and underwater acoustic systems are addressed in the biological resources portion of this document (Sections 3.6.2). The primary source of noise at proposed test locations is from the SH-60R, support equipment (range clearance aircraft vessels), and test activities. Helicopter noise levels vary based upon the type of tests being performed and the mode of operation (i.e., hovering). Most tests will be conducted within established military test, operating, and training ranges. Any noise disturbances to populated human activity areas at the land-based ranges will be brief and of short duration.

For operations conducted in military test, operating, and training ranges over water, impacts to human receptors are considered remote since proposed test locations are cleared of unauthorized test personnel prior to initiation of the test event. In addition, proposed tests are similar in scope to existing activities conducted at these locations.

Likewise, noise will also be generated from missile firings. The sound intensity from a HELLFIRE missile launch is approximately 149 dB(A) at 4.5 m (15 ft) in altitude. The noise levels generated during SH-60R missile launches are transient and short in duration and are not expected to result in significant impacts.

The potential exists for startle effects to wildlife, but mammals seem less disturbed than birds by aircraft noise. However, studies conducted near existing airfields and airport construction sites have shown that these effects are short in duration (U.S. DoN, 1997a). Environmental resource management and protection programs established at these military ranges also help to minimize significant effects to wildlife. For example at NAS PRC, there are established procedures for discouraging birds in and around the airfields, limiting the use of selected airspace in the CTR during nesting periods at nearby wildlife refuges, and modifying flight-time periods during peak waterfowl migratory months. Therefore, no significant impacts are expected to occur to the populations of individuals, species, or their habitats during the proposed SH-60R testing program.

3.4 Socioeconomics

The socioeconomic impacts of the Proposed Action center around the commercial fishing industry. Other major sources of socioeconomic change (including the fluctuation in the number of support personnel, the building of new facilities, or the closing of old ones) will not be factors in the implementation of SH-60R DT and OT.

Data on the socioeconomics of commercial fisheries have been collected by the National Marine Fisheries Service (NMFS) on commercial (U.S. and foreign) and recreational fishing and associated activities (e.g., supply of fishery products, cold storage) for the U.S. and the world. Some of this information is available on the World Wide Web at http://www.st.nmfs.gov/ commercial/landings/caveat.html. Landing summary data included on this site are based on information contained in eight NMFS databases that overlap in time and geographic coverage. These data are used in the consideration of the potential economic impact of the marine fisheries within the proposed test locations.

3.4.1 Affected Environment

The following discusses the existing socioeconomic environment at each proposed test location.

3.4.1.1 NAS PRC

Approximately half of the NAS PRC lies over the Chesapeake Bay and its tributaries, where commercial fisheries provide an important source of income for local residents and commercial fishing. It is an important sector of the MD and VA economies. The NMFS statistics show that in 1997 the commercial harvest of fish and shellfish from MD and VA waters in the Chesapeake Bay totaled more than 300,000 metric tons (661.5 million lbs), for a reported retail value of more then $165 million (NMFS, 1999).

3.4.1.2 AWA

Commercial fishing is an important source of income for local residents in MD, DE, and VA. The NMFS statistics show that in 1997 the commercial harvest of fish and shellfish from waters off the coast of MD, DE, and VA totaled more than 304 thousand metric tons (670 million lbs), for a reported retail value of more then $170 million (NMFS, 1999).

3.4.1.3 Ex-USS Salmon Site

The NMFS statistics show that in 1997 the commercial harvest of fish and shellfish off the coast of NJ totaled more than 79.4 thousand metric tons (175.1 million lbs), for a reported retail value of more than $100 million (NMFS, 1999).

3.4.1.4 MCAS Cherry Point

NMFS statistics show that in 1997 the commercial harvest of fish and shellfish from waters off the coast of NC totaled more than 103.6 thousand metric tons (228.4 million lbs) for a reported retail value of more then $104 million (NMFS, 1999).

3.4.2 Socioeconomic Consequences

This section addresses the potential socioeconomic effects to the commercial fishing industry during proposed SH-60R tests. Due to the varied test areas at each location, the Proposed Action is not expected to affect commercial fishery stocks or fishing activities. The frequency and duration of each test event varies throughout the year and as such should not impact daily, weekly, or monthly commercial fishing activities.

Proposed tests do not disturb the water or subsurfaces significantly, nor are there changes in access to fishing areas. Water quality changes are minor and will not affect fish and shellfish populations. As such, implementation of the proposed SH-60R DT and OT is not expected to significantly impact the commercial fishing industry and associated socioeconomics.

3.5 Coastal Zone Management

Delaware, Maryland, Virginia, and North Carolina have Federally-approved coastal zone management (CZM) programs under Section 306 of the Federal Coastal Zone Management Act (CZMA) of 1972, as amended. These management plans provide for the protection of natural resources and the husbandry of coastal development. The CZMA provides a procedure for the states to review Federal actions for consistency with their own approved coastal management program, and it also provided approved states with matching Federal funding to administer their programs (U.S. DoN, 1998f).

Furthermore, Section 307 (c)(1) of the Federal CZMA Reauthorization Amendments (CZMARA) of 1979, states that each Federal agency conducting or supporting activities affecting any land, water use, or natural resource of the coastal zone must do so in a manner to the maximum extent practicable, consistent with the enforceable policies of each State’s CZM program and policies.

3.5.1 Affected Environment

3.5.1.1 NAS PRC

NAS PRC is surrounded by MD’s coastal zone. In addition, DE, MD, and VA have lands underlying the CTR. The coastal management policies, objectives, and goals applicable to the Proposed Action are briefly explained below for these states.

- Delaware’s Coastal Management Program (DCMP) includes a policy for National Defense Facilities that recommends military agencies comply with regulatory and environmental standards imposed under Federal law, and encourages those agencies to cooperate with state and local governments for the protection and enhancement of the environment (U.S. DoN, 1998f). Delaware’s *Comprehensive Update and Routine Program Implementation of 1993* specifies DCMP policies that would require consideration with respect to the Proposed Action including: (1) Coastal Waters Management; (2) Natural Areas Management; (3) Woodlands and Agricultural Lands; (4) Living Resources; and (5) Air Quality.

- Maryland’s CZM Program is based on Federal laws, such as Section 404 of the Clean Water Act of 1977, as well as existing State laws and authorities, such as the Chesapeake Bay Critical Area Program (established in 1984), the Tidal Wetlands Act of 1970, the Non-Tidal Wetlands Protection Act of 1989, and the State’s authority under Section 401 of the Clean Water Act of 1977. Compliance with relevant Federal and State regulatory programs constitutes consistency with the policies of the Coastal Resources Division of the MDNR.

- Virginia’s Coastal Resources Management Program (CRMP) establishes policies and objectives to guide the use and development of coastal management areas to ensure their protection and preservation. In 1985, the Office of Ocean and Coastal Resources Management identified those environmental areas that require consideration when proposing any plan that may impact coastal zone areas. Policies that would potentially require consideration with respect to the Proposed Action include: (1) Fisheries Management; (2) Subaqueous Lands Management; (3) Point Source Pollution Control; and (4) Air Pollution.

The Navy complies, to the maximum extent practicable, with State coastal management policies. In recent years, NAS PRC has implemented several projects with the objective of improving water quality by controlling point and nonpoint sources of water pollution. Other efforts to stabilize the NAS PRC shoreline and prevent erosion have involved constructing stone groins or offshore breakwaters, regarding embankments to a stable slope, nourishing beaches with fresh sand, and establishing marsh grasses or dune vegetation.

3.5.1.2 MCAS Cherry Point

In 1978, the Federal Office of Coastal Zone Management approved, in accordance with the CZMA, the North Carolina Coastal Management Plan. This plan includes the provisions of the Coastal Area Management Act (CAMA) of 1974, Chapter 15, Subchapter 7, of the North Carolina Administrative Code and Federally approved local land use plans. For the purpose of a consistency determination, Federal actions are required to be consistent, to the maximum extent practicable, with the enforceable policies of the plan, CAMA, and the approved local land use plans of Craven and Carteret counties and the City of Havelock. The Marine Corps complies, to the maximum extent possible, with NC coastal management policies.

3.5.2 Coastal Zone Management Environmental Consequences

Potential impacts of the Proposed Action on the coastal zone management programs of DE, MD, VA, and NC are discussed in this section. As required by Section 307 (c)(1) of the CZMA, the consistency determination for a Proposed Federal Action affecting a State's coastal zone should be based on whether that action would be consistent with the State's enforceable CZM policies. Consistency should be to the maximum extent practicable. In its current operations at NAS PRC, the Navy is consistent with the CZM policies of DE, MD, and VA. Likewise, the Marine Corps conducts their current operations in a consistent manner with the North Carolina Coastal Management Plan and CAMA.

No construction is required for the Proposed Action, so tidal wetlands would not be affected nor would the discharge of dredged or fill material occur. Also, the Proposed Action would generate neither additional stormwater nor increase erosion and sedimentation into the surrounding waters. Potential impacts to finfish and shellfish resources from implementing the Proposed Action would be minimal since mortality from impact of a store would be unlikely. With respect to air quality, emission rates from helicopter flights would be less than the applicability rates for criteria pollutants and are projected to be below *de minimis* levels, therefore a formal conformity analysis would not be required (see Section 3.1). Marine mammals and sea turtles could potentially be affected from the use of ALFS in the CTR. ALFS will not be used at MCAS Cherry Point. However, based on the analysis in Section 3.6.2.1, it has been determined impacts in the CTR and NAS PRC are not significant or adverse given the short duration of ALFS use (one short duration ping to ensure the system functions properly), the low likelihood of encountering a marine mammal or sea turtle, and implementation of visual and passive monitoring.

There would be no coastal zone management impacts with continued adherence to environmental protection programs already in place at NAS PRC and MCAS Cherry Point. In summary, the Navy has determined flights and related operations conducted under the Proposed Action would, to the maximum extent practicable, comply with and be carried out in a manner consistent with the coastal zone management programs of DE, MD, and VA and NC. The Navy is currently coordinating this determination with the MDE and the North Carolina Department of Environment, Health, and Natural Resources, Division of Coastal Management.

3.6 Biological

Biological resources are plants, animals, and their habitats that are native to an area, including threatened or endangered species. Of the potential affected biological resources, the predominant species of concern from implementing the Proposed Action are marine species. The primary focus of this section is, therefore, on the potential effects of man-made underwater sound on marine mammals and sea turtles from test events. Other species (land-based animals and birds) are briefly discussed within this section. The Endangered Species Act (ESA) of 1973 (16 United States Code (USC) 1531, et seq.) protects threatened and endangered species against "taking," and agencies must ensure that their actions will neither (1) adversely impact the existence of threatened or endangered species nor (2) destroy or adversely modify the habitat on which such species depend. All sea turtles, many marine mammal species, and some fish species are protected under the ESA. The Marine Mammal Protection Act (MMPA) of 1972 (16 USC 1361 et seq.) also protects all marine mammals (e.g., whales and dolphins) against "taking" (i.e., harassing, hunting, capturing, or killing) without special permits. Table 3-14 identifies the marine species found in the proposed test areas. In order for marine species to be affected by proposed SH-60R/ALFS DT and OT operations, the species must have the potential to be in the area of the testing and must be sensitive to the MF band of the sonar equipment being tested (i.e., 3 to 9 kHz). For an expanded discussion of the natural history accounts for each marine species found in the proposed SH-60R/ALFS test areas, refer to Appendix D.

Table 3-14:
Marine Species Found in the Proposed SH-60R/ALFS Test Areas

Mysticetes	Odontocetes	Pinnipeds	Sea Turtles
▪ Blue whale ▪ Fin whale ▪ Minke whale ▪ Humpback whale ▪ Northern right whale	▪ Sperm whale ▪ Pygmy and dwarf sperm whale ▪ Northern bottlenose whale ▪ Cuvier's beaked whale ▪ Mesoplodon or beaked whale ▪ Pilot whale ▪ Risso's dolphin ▪ Common dolphin species, short- and long-beaked ▪ Stenella dolphins—striped, Atlantic spotted, spinner, and Clymene ▪ Bottlenose dolphin ▪ Atlantic white-sided dolphin ▪ Harbor porpoise	▪ Harbor seal	▪ Leatherback sea turtle ▪ Loggerhead sea turtle ▪ Green sea turtle

Literature searches have been used to gather information on biological resources. Data obtained for areas associated with potential test sites vary greatly in quantity, quality, and comparability, particularly for marine mammals. Despite this variability, the best available data for animal distributions and abundances were used to estimate potential effects. No effects on the biological environment are anticipated, as the following detailed description supports.

There are four sources of in-water acoustic energy that could potentially affect the marine animals inhabiting or frequenting the sites identified in this document. These sources are:

1) ALFS, 2) AN/AQS-13F sonar transmissions, 3) AN/SSQ-62 sonobuoy transmissions, and 4) SH-60R engine or equipment noise which enters the water. Each effect of these acoustic energy sources will be discussed in Section 3.6.2.

3.6.1 Affected Environment

The following discusses the existing biological environment at each proposed test location.

3.6.1.1 NAS PRC

The proposed CTR test site is located in water depths of approximately 34 m (110 ft). The Chesapeake Bay is a shallow, well-mixed estuary in which the acoustic environment does not vary significantly with each season. Effectively, since the water is well-mixed, the sound velocity profile is nearly isospeed (i.e., no sound is being trapped at any particular water depth or layer). This means there is minimal refraction, or bending, of the acoustic waves. Due to the shallowness of the water, the energy is therefore reflected off the surface and the bottom, effectively reaching all depths in the water column. Because of the way the sound propagates through the water column, the depth of the source does not greatly vary the acoustic effects.

Nine species of marine animals could potentially occur in the CTR (Table 3-15). There are very limited data available detailing the marine species found in the Chesapeake Bay, their abundance, or distribution patterns. To date, the only systematically collected data available are those of animals that have been stranded and have been reported to the Marine Animal Rescue Program at the National Aquarium in Baltimore (National Aquarium, 1997). A qualitative estimate of the probability of encountering each species in each season (Table 3-15) can be made from the detailed distribution information and density calculations presented in Section 3.6.2.1. For the purposes of this document, the probability of encountering a species was considered high if the species had an estimated density greater than 0.005 animals/nm^2 (i.e., > 1,000 animals in the Chesapeake Bay), medium if the estimated density was between 0.0005 and 0.005 animals/nm^2 (i.e., 100-1,000 animals in the Chesapeake Bay), and low if the estimated density is less than 0.0005 animals/nm^2 (i.e., < 100 animals in the Chesapeake Bay). Detailed descriptions of the animal species can be found in Appendix D.

Table 3-15:
Marine Animals Potentially Present in the CTR

Species	*Probability of Being Present During the Test*				ESA Status
	Winter	Spring	Summer	Fall	
Mysticetes					
Fin whale (*Balaenoptera physalus*)	Low				Endangered
Minke whale (*Balaenoptera acutorostrata*)	Low				
Humpback whale (*Megaptera novaeangliae*)	Medium				Endangered
Odontocetes					
Bottlenose dolphin (*Tursiops truncatus*) - Coastal stock		High	High		Depleted (Marine Mammal Protection Act)
Harbor porpoise (*Phocoena phocoena*)	Medium				Proposed for listing (ESA)
Pinnipeds					
Harbor seal (*Phoca vitulina*)	Low				
Sea Turtles					
Leatherback (*Dermochelys coriacea*)		Low	Medium	Low	Endangered
Loggerhead (*Caretta caretta*)	Low	Low	Low	Low	Threatened
Atlantic green (*Chelonia mydas*)			Low		Endangered

Many waterfowl and songbird species inhabit the Chesapeake Bay region and/or migrate along the Atlantic Flyway of which a portion intersects NAS PRC. Large concentrations have been identified during the migration season (fall, spring). The American Bald Eagle, a Federally threatened species that is currently proposed to be delisted by the United States Fish and Wildlife Service (USFWS), is found inhabiting and nesting near NAS PRC. It has also been sighted at Bloodsworth Island, Smith Island, and Fox Island in the CTR and local flying areas.

Additional information regarding details of existing biological resource environment is available in the *Final Environmental Impact Statement for Increased Flight and Related Operations in the Patuxent River Complex, Patuxent River, Maryland* (U.S. DoN, 1998f).

3.6.1.2 AWA

The AWA includes waters in the Mid-Atlantic Bight (MAB), extending from the DE coast to the southern VA coast seaward, with water depths ranging from 0 to roughly 4,000 m (0-13,123 ft). The proposed ALFS test sites are located at the continental shelf edge, with maximum water depths of approximately 2000 m (6562 ft). The AWA is a deep test site that exhibits a surface duct in the fall and winter. Below the surface duct, acoustic energy is refracted towards the seafloor. During the spring and summer, no surface duct exists; therefore, the depth of the source is not a significant factor in estimating potential effects. (See Table 3-16.)

Table 3-16:
Depths of Seasonally-Varying Surface Ducts

Test Sites	Surface Duct Depths	
	Fall/Winter	Spring/Summer
AWA	0-400 ft (0-122 m)	No surface duct

Twenty-three species of marine animals could potentially occur in the AWA (Table 3-17). Despite its historical nature, data from the Cetacean and Turtle Assessment Program (CeTAP) surveys (1979-1982) represent the best available, most comprehensive coverage of marine habitats off the northeast U.S. (Kenney et al., 1997). Therefore, whenever possible, these data were utilized to determine which species may be present in the area and to estimate animal densities. A qualitative estimate of the probability of encountering each species in each season (Table 3-17) can be made from the detailed distribution information and density calculations presented in Section 3.6.2.2. For the purposes of this document, the probability of encountering a species was considered high if the species had an estimated density greater than 0.05 animals/nm^2 (i.e., > 1,000 animals in the MAB), medium if the estimated density was between 0.005 and 0.05 animals/nm^2 (i.e., 100-1,000 animals in the MAB), and low if the estimated density is less than 0.005 animals/nm^2 (i.e., < 100 animals in the MAB). Detailed descriptions of the animal species are found in Appendix D.

Table 3-17:
Marine Animals Potentially Present in the AWA

Species	*Probability of Being Present During the Test*				ESA Status
	Winter	**Spring**	**Summer**	**Fall**	
Mysticetes					
Blue whale (*Balaenoptera musculus*)	Low				Endangered
Fin whale (*Balaenoptera physalus)*	Medium	High	Medium	Medium	Endangered
Minke whale (*Balaenoptera acutorostrata*)		Medium	Medium		
Humpback whale (*Megaptera novaeangliae*)		Medium		Medium	Endangered
Northern right whale (*Eubalaena glacialis*)		Low		Low	Endangered
Odontocetes					
Sperm whale (*Physeter macrocephalus*)	Medium	High	Medium	Medium	Endangered
Dwarf & Pygmy sperm whale *(Kogia* spp.)		Low			
Cuvier's beaked whale (*Ziphius cavirostris*)		Medium	Low		
Beaked whales (*Mesoplodon* spp.)		Medium	Medium		
Northern bottlenose whale (*Hyperoodon ampullatus*)		Low			
Pilot whale (*Globicephala* spp.)	Medium	High	High	High	
Risso's dolphin *(Grampus griseus*)	Medium	High	High	High	
Common dolphin (*Delphinus delphis*)	High	High	High	High	
Bottlenose dolphin (*Tursiops truncatus*) offshore stock	Medium	High	High	High	
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Medium				
Striped dolphin (*Stenella coeruleoalba*)	High	High	High	High	
Atlantic spotted dolphin (*Stenella frontalis*)	Medium	High	High	Medium	
Spinner dolphin (*Stenella longirostris*)		Medium	Low		
Harbor porpoise (*Phocoena phocoena*)		High		High	Proposed for listing (ESA)
Pinnipeds					
Harbor seal (*Phoca vitulina*)	Low				
Sea Turtles					
Leatherback (*Dermochelys coriacea*)		Low	Low	Low	Endangered
Loggerhead (*Caretta caretta*)	Low	Low	Low	Low	Threatened
Green (*Chelonia mydas*)			Low		Endangered

3.6.1.3 Ex-USS Salmon Site

The proposed test site is located approximately 60 nm east-southeast of New York City, off the coast of NJ. Like the CTR site, the Ex-USS *Salmon* site is a shallow site (approximately 400 ft (122 m) deep). However, unlike the CTR, the Ex-USS *Salmon* site can exhibit a relatively strong surface duct in the fall and winter, and a weaker near-surface duct in the spring and summer. Therefore, the depth of the source is a factor in estimating potential effects (Table 3-18). The water column of the Ex-USS *Salmon* site is divided in half by the axis of the sound channel, creating different acoustic propagation conditions for a shallow source (i.e., above the channel axis) versus a deep source (i.e., below the channel axis).

Table 3-18:
Depths of Seasonally-Varying Surface Ducts

Test Sites	Surface Duct Depths	
	Fall/Winter	Spring/Summer
Ex-USS *Salmon* Site	0-200 ft (0-61 m)	0-100 ft (0-30.5 m)

Twenty-two species of marine animals could potentially occur in the vicinity of the Ex-USS *Salmon* site (Table 3-19). Despite its historical nature, data from the CeTAP surveys (1979-1982) represent the best available, most comprehensive coverage of marine habitats off the northeast U.S. (Kenney et al., 1997). Therefore, whenever possible, these data were utilized to determine which species may be present in the area and to estimate animal densities. A qualitative estimate of the probability of encountering each species in each season (Table 3-19) can be made from the detailed distribution information and density calculations presented in Section 3.6.2.3. For the purposes of this document, the probability of encountering a species was considered high if the species had an estimated density greater than 0.05 animals/nm^2 (i.e., > 1,000 animals in the southern New England area (SNE)), medium if the estimated density was between 0.005 and 0.05 animals/nm^2 (i.e., 100-1,000 animals in the SNE), and low if the estimated density is less than 0.005 animals/nm^2 (i.e., < 100 animals in the SNE). Detailed descriptions of the animal species are found in Appendix D.

Table 3-19:
Marine Animals Potentially Present in the Vicinity of the Ex-USS *Salmon* Site

Species	*Probability of Being Present During the Test*				ESA Status
	Winter	**Spring**	**Summer**	**Fall**	
Mysticetes					
Blue whale (*Balaenoptera musculus*)	Low				Endangered
Fin whale (*Balaenoptera physalus)*	Medium	Medium	High	Medium	Endangered
Minke whale (*Balaenoptera acutorostrata*)	Medium	High			
Humpback whale (*Megaptera novaeangliae*)		Medium		Medium	Endangered
Northern right whale (*Eubalaena glacialis*)		Low		Low	Endangered
Odontocetes					
Sperm whale (*Physeter macrocephalus*)	Low	Medium	Medium		Endangered
Dwarf & Pygmy sperm whale *(Kogia* spp.)			Low		
Cuvier's beaked whale (*Ziphius cavirostris*)		Low	Medium		
Beaked whales (*Mesoplodon* spp.)		Medium	Medium		
Pilot whale (*Globicephala* spp.)	Medium	High	Medium	High	
Risso's dolphin *(Grampus griseus*)	Low	High	High	Low	
Common dolphin (*Delphinus delphis*)	High	High	High	High	
Bottlenose dolphin (*Tursiops truncatus*) offshore stock	Medium	High	High	Medium	
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Low	High		Low	
Striped dolphin (*Stenella coeruleoalba*)	High	High	High	Medium	
Atlantic spotted dolphin (*Stenella frontalis*)	Medium	Medium	Medium	Medium	
Spinner dolphin (*Stenella longirostris*)			Medium		
Harbor porpoise (*Phocoena phocoena*)		High			Proposed for listing (ESA)
Pinnipeds					
Harbor seal (*Phoca vitulina*)	Low				
Sea Turtles					
Leatherback (*Dermochelys coriacea*)		Low	Low	Low	Endangered
Loggerhead (*Caretta caretta*)	Low	Low	Low	Low	Threatened
Green (*Chelonia mydas*)			Low		Endangered

3.6.1.4 MCAS Cherry Point

The MCAS Cherry Point Operating Area is located at the confluence of the Neuse River Watershed and the Pamlico Sound. Warning areas associated with the MCAS Cherry Point Operating Area extend approximately 219 km (120 nm) east of NC coast into the North Atlantic Ocean and include W-122, R-5306A and C, and A-530 ranges. Table 3-20 lists the twenty-one species of marine animals that could potentially occur in the vicinity of the MCAS Cherry Point Operating Area for each season, and the probability of encountering those species. For the purposes of this document, an animal density was considered high if it was greater than 0.05 animals/nm^2 (i.e., >1000 animals in the MAB), medium if between 0.005 and 0.05 animals/nm^2 (100-1000 animals in the MAB), and low if less than 0.005 animals/nm^2 (< 100 animals in the MAB). Detailed descriptions of the animal species can be found in Appendix D.

Forested areas in the MCAS Cherry Point Operating Area support a wide variety of wildlife. Depending on the natural community, these areas support mammal species such as whitetail deer, gray fox, river otter, beaver, raccoon, opossum, and eastern cottontail. Other mammals such as the black bear, red fox, and bobcat are present, but occur less frequently. Bird species include a variety of songbirds, woodpeckers, and raptors (U.S. DoN, 1998d). The American

Bald Eagle, currently proposed to be removed from the Federal threatened and endangered species list by the USFWS, occurs at the station on an infrequent basis.

Table 3-20:
Marine Animals Potentially Present in the MCAS Cherry Point Operating Area

Species	*Probability of Being Present During the Test*				ESA Status
	Winter	Spring	Summer	Fall	
Mysticetes					
Blue whale (*Balaenoptera musculus*)	Low				Endangered
Fin whale (*Balaenoptera physalus)*	Medium	Low	Low	Medium	Endangered
Minke whale (*Balaenoptera acutorostrata*)	Medium			Medium	
Humpback whale (*Megaptera novaeangliae*)		Medium		Medium	Endangered
Northern right whale (*Eubalaena glacialis*)		Low		Low	Endangered
Odontocetes					
Sperm whale (*Physeter macrocephalus*)	Low	Low	Low	Low	Endangered
Dwarf & Pygmy sperm whale *(Kogia* spp.)	Low			Low	
Cuvier's beaked whale (*Ziphius cavirostris*)		Medium	Low		
Beaked whales (*Mesoplodon* spp.)		Medium	Medium		
Pilot whale (*Globicephala* spp.)	High	High	High	High	
Risso's dolphin *(Grampus griseus*)	Medium	High	High	High	
Common dolphin (*Delphinus delphis*)	High	High	High	High	
Bottlenose dolphin (*Tursiops truncatus*) offshore stock	High	Medium	Medium	High	
Bottlenose dolphin (*Tursiops truncatus*) coastal stock		High	High		Depleted (MMPA)
Striped dolphin (*Stenella coeruleoalba*)	High	High	High	High	
Atlantic spotted dolphin (*Stenella frontalis*)	Medium	High	High	Medium	
Spinner dolphin (*Stenella longirostris*)		Medium	Medium		
Clymene dolphin (*Stenella clymene*)			Low		
Sea Turtles					
Leatherback (*Dermochelys coriacea*)	Low	Low	Low	Low	Endangered
Loggerhead (*Caretta caretta*)	Low	Low	Low	Low	Threatened
Green (*Chelonia mydas*)		Low	Low	Low	Endangered

MMPA = Marine Mammal Protection Act

An inventory of rare species, natural communities, and critical areas at MCAS Cherry Point was completed in 1994. The survey indicated that four species listed as threatened or endangered by the USFWS or by the State of NC could be present in the vicinity of MCAS Cherry Point. The American alligator is Federally threatened by similarity of appearance (T S/A). It is associated with Hancock and Slocum creeks and their larger tributaries. The entire Hancock Creek drainage in the vicinity of the station is identified as a Natural Heritage Program critical area (not a critical habitat) because of the occurrence of the alligator and natural communities. Finally, spring goldenrod, a State-listed endangered plant species, occurs at several locations at the station (U.S. DoN, 1998d).

Threatened or endangered species that commonly occur in Pamlico Sound, and therefore at the BT-9 target on Brant Island Scholl, are the Green sea turtle, Kemp's Ridley sea turtle, and the Loggerhead sea turtle. Bird and amphibian or reptilian species that may occur at the BT-11 Piney Island Target are shown in Table 3-21.

**Table 3-21:
State and Federally Listed Species Potentially Occurring
at BT-11 at Piney Island Target**

Common Name	Federal Status	State Status	Habitat
Black rail	-	SR	BM, MST
Northern harrier	-	SR	BM, MST
Black-neck stilt	-	SR	BM
Black skimmer	-	SC	BCH, OW
Gull-bill tern	-	T	BCH, BM, OW
Snowy egret	-	SC	BM
Little blue heron	-	SC	BM
Tri-colored heron	-	SC	BM
Glossy ibis	-	SC	BM
Diamond backed terrapin	-	SC	BM, OW
Carolina saltmarsh snake	-	SC	BM

Adopted from U.S. DoN, 1998d
Key: SC = Species of concern; SR = Significantly rare species; T = Threatened; BCH = Beach; BM = Brackish marsh; MST = Maritime shrub thicket; OW = Open water.

Additional information regarding biological resources found at MCAS Cherry Point and the associated target ranges can be found in the *Final Environmental Impact Statement for the Realignment of F/A-18 Aircraft and Operational Functions form the Naval Air Station Cecil Field, Florida to other East Coast Installations* (U.S. DoN, 1998d).

3.6.2 Biological Environmental Consequences

Regarding wildlife (including birds and land-based mammals) at the testing areas, the risks that are characteristically associated with aircraft operations include the potential to collide with wildlife and to create noise disturbances. Effects to land animals are expected to be low because (1) the majority of test events will be conducted over established airfields and ranges over water and (2) the SH-60R tests do not greatly increase the volume of aircraft flights, thus minimizing any additional risk of collision. Natural resource management plans and other procedures to protect species, as well as aircraft, are implemented at proposed test locations to minimize impacts to wildlife. Consequences to non-aquatic species are not expected to be significant and are not analyzed further in this section.

The focus of this section, therefore, is the analysis of the potential effects of man-made underwater sound on marine species, specifically on sea turtles and marine mammals. They are the predominant species of concern during the proposed SH-60R tests, especially during active acoustic transmissions test events. The potential effects on marine mammals specifically depend on the general source specifications (source level, frequency, beam patterns, etc.), the depth at which the source will transmit, and the acoustic environments (i.e., acoustic propagation characteristics) of the test sites. This information, when combined with the acoustic received levels at which the marine animals exhibit behavior modification or Temporary Threshold Shift (TTS) in their hearing, allows the determination of Zones of Influence (ZOIs) for each of the sources.

There are four acoustic sound sources present during the proposed testing that could potentially affect the underwater marine environment. They are: ALFS source, the AN/AQS-

13F source, AN/SSQ-62 sonobuoys, and helicopter engine or machinery noise, which enters the water through the sea surface. ALFS operates in the frequency band of 3-5 kHz, but the bandwidth of an individual pulse is less than 1 kHz. Pulse lengths are less than 10 s, and typically less than 1 s. The duty cycle is less than or equal to 10 percent, with a pulse repetition rate of 0.01-70 s. The maximum SL is less than 220 dB re 1 μPa at 1-m. The AN/AQS-13F operates in the frequency band of 9-11 kHz. Pulse lengths range between 3.5 and 700 msec and the sound pressure level of the omnidirectional transducer is approximately 216 dB. The AN/SSQ-62 sonobuoy is an expendable source, which can be deployed from the SH-60R aircraft, and consists of a battery-powered, ceramic transducer; the transducer produces approximately 50 ping-seconds (i.e., about 50 1-second transmissions) at a source level of 202 dB re 1 μPa at 1m (3 ft), in the frequency range of 6.5-9.5 kHz. It has a typical duty cycle of 10 percent or less.

The final acoustic source, SH-60R noise, is a by-product of the presence of the aircraft itself. Whale reactions to helicopter noise are inconsistent and appear to be dependent on the behavior the animal is involved in at the time, weather conditions, and the loudness, altitude, and speed of the helicopter. Likewise, the degree of response seems to be distinctly variable between species. Lower level engine noise or minor vessel maneuvering may not induce a reaction from a whale (Watkins, 1986); however, if the disturbance is intense, the whale may be forced to alter its behavior. Feeding, socializing, or courting whales appear less disturbed by aircraft than whales engaged in other activities (Richardson et al., 1995). In contrast, avoidance reactions may be more intense in calves or females with calves (NMFS, 1991).

Numerous observations of marine mammal reactions (or lack of reaction) to aircraft have been reported. In most cases, airborne or waterborne noise from aircraft was the apparent stimulus (Richardson et al., 1995). The following paragraphs summarize observed reactions of marine mammals found in the proposed test areas to the noise generated by low flying helicopters.

- **Pinnipeds:** Harbor seals have been noted to react to aircraft flyovers when on the beach. In the case of helicopter flyovers of less than 120 m (393 ft), mothers have abandoned newborn pups and retreated into the water. This behavior can result in permanent separation of newborn pups and subsequent death (Johnson, 1967). Other studies have shown less drastic reactions. Hoover (1988) reported strong reactions to aircraft below 61m (200 ft), but minimal reaction to aircraft above 76 m (250 ft). Other studies have suggested that harbor seals can become sensitized to overflights and show little or no reaction after frequent exposure (Frost and Lowry, 1993; Bigg as cited in Johnson et al., 1989).
- **Odontocetes** do not appear to respond to aircraft noise as often as pinnipeds. Various studies of sperm whales have not shown a reaction to helicopters at very low altitude, except when the subject was in the obvious downwash (Clarke, 1956). Beaked whales have been noted to dive immediately in response to flyover (CeTAP, 1982; Dohl et al., 1983; Mullin et al., 1991).
- **Mysticetes**: Richardson et al. (1995) report that baleen whale reactions to aircraft are minimal. Right whales have shown very little response to low flying aircraft. Feeding northern right whales apparently ignored a light aircraft circling overhead at 50 m to 300 m (164–984 ft) (Watkins and Schevill, 1977). Single whales may show a greater response than socialized groups (Payne and Heinemann, 1993). No known studies of the responses of humpback whales

are available (Richardson et al., 1995), and individual reported reactions are not uniform (reactions observed for overflights of 305 m (1000 ft) and no apparent response to overflights at 152 m (500 ft) (Shallenberger, 1978).

In summary, although marine mammals and sea turtles could potentially respond to overflights by SH-60R aircraft and alter their behavior, the studies cited above indicate that the probability of this is low. Additionally, the aircraft involved in the DT and OT tests will either be transiting to the test area or operating at those test sites. For the aircraft transiting to testing areas, the routes flown will typically be at a greater altitude than the studies cited above and the aircraft will not be lingering in any area.

For the aircraft operating in the test site, it is estimated that the sound levels associated with the SH-60R will be similar to the current H-60 series helicopters since the engines are the same. In 1991, the Air ASW Systems Program Office conducted tests to determine the effects of in-water H-60 helicopter noise on ASW operations (U.S. DoN, 1991). During these tests, an H-60 flew over calibrated sonobuoys (receiver depth 122 m (400 ft)) at altitudes ranging from 76 to 1525 m (250 to 5000 ft). Results showed a relatively flat spectrum (increases of approximately 1 to 5 dB over ambient) below 200 Hz rising to a maximum increase of 18 dB between 2 and 3 kHz. Models to determine precise in-water, near-surface noise levels are not reliable for all sea surface conditions. However, knowing that the ALFS will only be operated in low sea states, and assuming a “nominal-case” scenario in that all the energy from the helicopter is transmitted directly to the hydrophones, then spherical spreading can be used to estimate near-surface point noise levels. These levels were estimated by adding 42.5 dB (calculated from spherical spreading) to the received levels at 122 m (400 ft) and by summing the energy across the entire spectrum. Table 3-22 provides a summary of the estimated equivalent in-water, near-surface spectrum noise level for an H-60 helicopter operating at 76 m (250 ft). When this energy is summed across the entire spectrum, the nominal case estimate is an in-water, near-surface total energy level of 142.2 dB for a helicopter hovering at 76 m (250 ft). This level could be higher if the helicopter hovers at a lower altitude. The lowest altitude expected during DT/OT is 15.2 m (50 ft), which would result in a 14 dB increase in the in-water, near-surface total energy level to 156.2 dB. This amount is below the threshold for potential effects even for the most sensitive marine mammal species; and therefore, no potential effects are expected from the hovering helicopter.

Since no effects are expected from either the transiting or hovering helicopter, potential effects of aircraft noise on marine mammals are not analyzed further.

Table 3-22:
Estimate H-60 In-Water, Near-Surface Noise Levels

Frequency	Spectrum Noise Level at 122 m (400 ft) Depth (dB re 1 µPa)	Estimated Near-Surface Spectrum Noise Level (dB re 1 µPa)
10 Hz	80	123
100 Hz	72	115
500 Hz	60	103
1 kHz	56	99
2.5 kHz	45	88
5 kHz	28	71

(U.S. DoN, 1991)

The depths at which acoustic sources (ALFS, AN/AQS-13F, and AN/SSQ-62 sonobuoys) will be employed varies from site to site and potentially even from ping to ping. Therefore, various depths will be examined to ensure that the entire range of possible effects is analyzed.

Each test site has an unique acoustic environment. The Chesapeake Bay is a shallow, well-mixed estuary in which the acoustic environment does not vary significantly with each season. In addition, the depth of the source is not a factor in estimating potential effects. Similarly, the Ex-USS *Salmon* site is a shallow site (approximately 400 ft (122 m) deep). However, unlike the CTR, the Ex-USS *Salmon* site can exhibit a relatively strong surface duct in the fall and winter, and a weaker near-surface duct in the spring and summer. Therefore, the depth of the source is a factor in estimating potential effects (Table 3-23). The water column of the Ex-USS *Salmon* site is divided in half by the axis of the sound channel, creating different acoustic propagation conditions for a shallow source (i.e., above the channel axis) versus a deep source (i.e., below the channel axis). The AWA is a deep test site that exhibits a surface duct in the fall and winter. Below the surface duct, acoustic energy is refracted towards the seafloor. During the spring and summer, no surface duct exists; therefore, the depth of the source is not a significant factor in estimating potential effects.

Table 3-23:
Depths of Seasonally-Varying Surface Ducts

Test Sites	Surface Duct Depths	
	Fall/Winter	Spring/Summer
NAS PRC	Test site too shallow for surface duct to form	
AWA	0-400 ft (0-122 m)	No surface duct
Ex-USS *Salmon* Site	0-200 ft (0-61 m)	0-100 ft (0-30.5 m)

Analysis of the acoustic environment during active transmission of the ALFS was conducted using the Parabolic Equation (PE) model version 3.4, an acoustic propagation loss model from the Navy's Oceanographic and Atmospheric Master Library (Holmes and Gainey, 1991). For acoustic environments that did not have a surface duct and did have water depths that supported spherical spreading, the acoustic analysis was conducted using the transmission loss equation for spherical spreading [20 log (R)]. The acoustic analysis was done for winter and summer conditions, representing the extremes in seasonal variation. Spring is a transition time from winter to summer conditions, but the acoustic environment is primarily dominated by the summer; therefore, the summer profile was used to estimate potential effects during the spring. Conversely for fall, while transitioning from summer to winter conditions, the fall acoustic environment can best be represented by the winter profile.

Currently, the most authoritative study available on the effects of acoustic signals on marine mammals at frequencies between 3 and 75 kHz is the study conducted by the Naval Command, Control and Ocean Surveillance Center (Ridgway et al., 1997). That study found that for 1-second tones at 3 kHz, small odontocetes (specifically bottlenose dolphin, *Tursiops truncatus*) experienced changes in behavior at 186 dB re 1 μPa, and TTS at 194-201 dB re 1 μPa. Therefore, in the absence of other data, these values were utilized to determine the ZOIs for all odontocetes. Additionally, it is believed that pinnipeds are less sensitive to in-water acoustic sound than odontocetes. Therefore, these conservative values were also used to calculate their ZOIs.

For mysticetes exposed to the proposed acoustic sources, levels of 160 dB re 1 μPa and 180 dB re 1 μPa were used as levels of behavior change and TTS, respectively. In the current absence of any mysticete data in this frequency range, these are the received levels that have been generally accepted within the marine bio-acoustic scientific community and by NMFS.

Although sea turtles can be found in very low densities near the proposed test sites, their hearing thresholds are suspected to be well below the 3-5 kHz frequencies produced by ALFS or the 6-10 kHz frequencies produced by either the AN/AQS-13F or the AN/SSQ-62. Sea turtle auditory systems have not been well studied, but Ridgway et al. (1969) concluded that the upper auditory limit for green turtles is 1 kHz with maximum sensitivity at 300 to 400 Hz. Similarly, Moein et al. (1994) reported a hearing range of about 250 to 1000 Hz for loggerhead sea turtles, and Lenhardt (1994) stated that maximal sensitivity in sea turtles generally occurs in the range from 100 to 800 Hz. Thus, the potential for any behavioral or TTS effects on sea turtles is negligible and will not be further analyzed in this document.

The three active sonars transmit in slightly different frequency bands. However, these frequencies are close enough that the received level values used to calculate the ZOIs for behavioral modification and TTS in marine mammals are identical for the three sources. Therefore, effectively, the only difference in these calculations is the source level for each sonar. Since the ALFS source is the strongest, it will be used in all subsequent ZOI calculations for this document. It conservatively approximates the effects of the AN/AQS-13F sonar and AN/SSQ-62 sonobuoys.

3.6.2.1 NAS PRC

Table 3-24 provides an estimate of animal densities for the NAS PRC. There are very limited data available detailing the marine species found in the Chesapeake Bay, their abundance, or distribution patterns. To date, the only systematically collected data available are of animals that have stranded and have been reported to the Marine Animal Rescue Program at the National Aquarium in Baltimore (National Aquarium, 1997). Fin whales, minke whales, and harbor seals have been recovered in the Chesapeake Bay, but their presence is unusual; therefore, their densities were estimated as extremely rare (0.0001 animals/nm^2).

The North Atlantic humpback whale is primarily a coastal species that travels over deep pelagic waters during migrations between higher latitude, summer feeding grounds (principally, the Gulf of Maine, eastern Canada, West Greenland, Iceland, and Norway) and lower latitude, winter breeding grounds (principally, the West Indies). However, based on a two-year, ocean-basin-wide survey of the North Atlantic, it was determined that a limited number of humpback whales do not migrate to the winter breeding grounds (Smith et al., 1999), and it is believed that a fraction of these “missing” animals remain in mid-Atlantic waters, primarily in the Chesapeake Bay (U.S. DoN, 1998f). Therefore, an intermediate density (0.022 animals/nm^2) was used as a conservative estimate for humpback whales in the Chesapeake Bay in winter. Furthermore, a study in the nearshore waters of Virginia Beach, VA, estimated a local abundance and distribution of coastal migratory bottlenose dolphins (Barco et al., 1999). This study area is at the mouth of the Chesapeake Bay, close to oceanic waters which had higher dolphin abundances. Therefore, it was estimated conservatively that the density in the NAS PRC would be half of that found in the study area. Finally, harbor porpoises have been stranded in the waters of the Chesapeake Bay (National

Aquarium, 1997) and are found in intermediate densities in the waters from NJ to NC in the winter (Waring et al., 1998). Waring et al. (1998) estimates the abundance of the Gulf of Maine/Bay of Fundy stock of harbor porpoises as 54,300. During winter (January to March), they are found in low densities from NY to New Brunswick, Canada, and in intermediate densities from NJ to NC. Therefore, estimating that two-thirds of the animals migrate to the NJ/NC region, an area of approximately 35,000 nm^2 (120,000 km^2), the density of harbor porpoises in the Chesapeake Bay was estimated as 1.0 animals/nm^2 (See Table 3-24).

Table 3-24:
Animal Density in the NAS PRC

Species	**Estimated Density (animals/ nm^2)**			
	Winter	**Spring**	**Summer**	**Fall**
Mysticetes				
Fin whale [1]	0.0001	0	0	0
Minke whale [1]	0.0001	0	0	0
Humpback [2]	0.022	0	0	0
Odontocetes				
Bottlenose dolphin – coastal stock [3]	0	0.25	0.75	0
Harbor porpoise [4]	1.0	0	0	0
Pinnipeds				
Harbor seal [1]	0.0001	0	0	0

Notes: 1. Estimated from stranding data from National Aquarium, 1997.
2. Estimated from Smith et al., 1999.
3. Estimated from Barco et al., 1999.
4. Estimated from Waring et al., 1998.

The CTR is a shallow water test site and because of its limited depth, the CTR does not have a surface duct. Therefore, ALFS transmissions were evaluated with one source depth, which placed the source in the middle of the water column. At this location, there is no seasonal variation in the acoustic environment. The year-round ZOIs are provided in Table 3-25. Behavioral effects for mysticetes could possibly occur at a distance of 0.5 nm from the source. To possibly incur TTS, mysticetes would have to be within 0.03 nm of the source. Odontocetes and pinnipeds would have to be within 0.03 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS.

Table 3-25:
Year Round ZOIs (nm) for ALFS at NAS PRC

Species	**Behavior**	**TTS**
Mysticetes	0.5	0.03*
Odontocetes	0.03*	0.005*
Pinnipeds	0.03*	0.005*

*For acoustic environments that did not have a surface duct and did have water depths that supported spherical spreading, the acoustic analysis was conducted using the transmission loss equation for spherical spreading [20 log (R)].

Table 3-26 presents estimates of the number of animals per species potentially affected by a single transmission of ALFS in the NAS PRC. When no animals are indicated as potentially affected, these species are not expected in the area in that season, or less than 0.00001 animals could possibly be affected by a single transmission.

Table 3-26:
Number of Animals Affected for a Single Transmission in the CTR

Species	Winter		Spring		Summer		Fall	
	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS
Mysticetes								
Fin whale	0.00008	0	0	0	0	0	0	0
Minke whale	0.00008	0	0	0	0	0	0	0
Humpback whale	0.01728	0.00006	0	0	0	0	0	0
Odontocetes								
Bottlenose dolphin – coastal stock	0	0	0.00071	0.00002	0.00212	0.00006	0	0
Harbor porpoise	0.00283	0.00008	0	0	0	0	0	0
Pinnipeds								
Harbor seal	0	0	0	0	0	0	0	0

Notes: Number of animals affected for a single transmission is calculated by multiplying the animal density from Table 3-24 by the area of the appropriate zone of influence in Table 3-25.

3.6.2.2 AWA

A qualitative assessment of the presence of marine animals was previously given in Section 3.6.1.2. A quantitative estimate of animal densities in the AWA can also be made (Table 3-27). Except for blue whale, humpback whale, northern right whale, dwarf and pygmy sperm whales, northern bottlenose whale, white-sided dolphin, and harbor seal, the abundances listed in Table 3-27 are from the CeTAP surveys (Kenney et al., 1997). Additional species that were not identified during CeTAP were included in this analysis based on known distribution patterns (Waring et al., 1998). Blue whales, white-sided dolphins, and harbor seals are found in temperate to subpolar waters, with seasonal migrations to mid-latitudes. Northern right whales and humpback whales are known to migrate from low latitude breeding grounds to high latitude feeding grounds. While it is known that northern right whales migrate primarily inshore of the shelf edge, it is believed that humpback whales predominantly migrate far offshore. Finally, dwarf and pygmy sperm whales have recently been identified as separate species, but are still difficult to distinguish while surveying at sea. However, it is believed that dwarf and pygmy sperm whales are found worldwide in temperate to tropical waters in small densities (Mullin, 1998).

The abundance estimates from the stock assessment reports were normalized to the same area sampled during the CeTAP surveys. During CeTAP, the entire MAB from the shoreline to the 2000-m (6562 ft) isobath was surveyed (19,800 nm^2 (67,891 km^2)). In Table 3-27, densities, as seen in the right columns, were calculated by dividing the abundances in the left columns by the survey area. The species that are marked by the following symbol (^) are typically found inshore of the shelf edge, and therefore inshore of the test site. Similarly, the species that are marked by the following symbol (*) are typically found offshore of the shelf edge, and therefore offshore of the test site. The densities of these species were reduced by 75 percent of the value listed in

Table 3-27 to account for their low densities at the shelf edge before estimates of the number of animals potentially affected by a single transmission (Table 3-29) were calculated.

A sample calculation follows. A total of 542 fin whales were counted in the MAB in winter during CeTAP. Therefore, the raw density of fin whales in the MAB (area surveyed was 19,800 nm^2) is 0.027 animals/nm^2. The ZOI for potential behavioral reactions of mysticetes in the AWA in the winter for a deep source is 0.35 nm, which equates to an area around the source of 0.3848 nm^2. The density of fin whales is then adjusted for their inshore distribution pattern (0.027 animals/nm^2/ 4) = 0.00675 animals/nm^2, and then multiplied by the ZOI area (0.00675 animals/nm^2 X 0.3848 nm^2), resulting in 0.00260 fin whales potentially affected by ALFS.

Table 3-27:
Animal Density in the AWA

Species	Abundance [1]				Density: 1998 NMFS Survey[2]	Density[3] (animals/sq. nm)			
	Winter	Spring	Summer	Fall		Winter	Spring	Summer	Fall
Mysticetes									
Blue whale	50	0	0	0		0.0025	0	0	0
Fin whale ^ [4]	542	1,066	135	358		0.027	0.054	0.0068	0.018
Minke whale ^	0	193	656	0		0	0.0097	0.033	0
Humpback whale ^	0	1,000	0	1,000		0	0.051	0	0.051
Northern right whale ^	0	53	0	53		0	0.0027	0	0.0027
Odontocetes									
Sperm whale	503	1,187	387	300		0.025	0.060	0.020	0.015
Dwarf & Pygmy sperm whales	0	0	0	0	0.0002	0	0.0002	0	0
Cuvier's beaked whale * [5]	0	402	43	0		0	0.020	0.0022	0
Beaked whales *	0	121	135	0		0	0.0061	0.0068	0
Northern bottlenose whale *	0	77	0	0		0	0.004	0	0
Pilot whales	304	1,779	3,056	6,527		0.015	0.090	0.15	0.33
Risso's dolphin	777	2,649	3,168	2,725		0.039	0.13	0.16	0.14
Common dolphin	10,562	8,100	1,959	2,010		0.53	0.41	0.099	0.10
Bottlenose dolphin offshore stock	774	3,982	4,902	4,809		0.039	0.20	0.25	0.24
White-sided dolphin	1,000	0	0	0		0.051	0	0	0
Striped dolphin	1,937	7,972	7997	6,734		0.098	0.40	0.40	0.34
Atlantic spotted dolphin *	107	1,074	1,336	799		0.0054	0.054	0.067	0.040
Spinner dolphin *	0	302	69	0		0	0.015	0.0035	0
Harbor porpoise ^	0	2,548	0	2,548		0	0.13	0	0.13
Pinnipeds									
Harbor seal	100	0	0	0		0.005	0	0	0

Notes:
1. From Kenney et al., 1997; Waring et al., 1998.
2. From Mullin, 1998. Left blank if data provided in previous column.
3. MAB area is 19,800 sq. nm.
4 This symbol (^) indicates a species typically found inshore of the test site.
5. This symbol (*) indicates a species typically found offshore of the test site.

Table 3-28 presents the ZOIs for this location during ALFS tests. For the AWA in the fall and winter, when the source is located below the surface duct (i.e., deeper than 122 m (400 ft)), potential behavioral effects for mysticetes could possibly occur at a distance of 0.35 nm from the source. To incur TTS, mysticetes would have to be within 0.03 nm of the source. When the source is located above the surface duct (i.e., shallower than 122 m (400 ft)), potential behavioral effects for mysticetes could possibly occur at a distance of 0.5 nm from the source. To incur TTS, mysticetes would have to be within 0.003 nm of the source. Odontocetes and pinnipeds would have to be within 0.003 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS.

Table 3-28:
ZOIs (nm) for ALFS at AWA Proposed Test Sites

AWA	**Fall/Winter**				**Spring/Summer**	
	Deep Source (> 400 ft)		Shallow Source (< 400 ft)		All Source Depths	
Species	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**
Mysticetes	0.35	0.03*	0.5	0.03*	0.35	0.03*
Odontocetes	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*
Pinnipeds	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*

* For acoustic environments that did not have a surface duct and did have water depths that supported spherical spreading, the acoustic analysis was conducted using the transmission loss equation for spherical spreading [20 log (R)].

During the spring and summer in the AWA, no surface duct exists; therefore, the depth of the source is not a significant factor in estimating potential effects. Thus, at any source depth, potential behavioral effects for mysticetes could possibly occur at a distance of 0.35 nm from the source. To incur TTS, mysticetes would have to be within 0.03 nm of the source. Odontocetes and pinnipeds would have to be within 0.03 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS.

Table 3-29:
Number of Animals Affected for a Single Transmission in the AWA

Species	Winter				Spring		Summer		Fall			
	Deep Source		Shallow Source		All Sources		Deep Source		Deep Source		Shallow Source	
	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS
Mysticetes												
Blue whale	0.00096	0.00001	0.00196	0.00001	0	0	0	0	0	0	0	0
Fin whale	0.00260	0.00002	0.00530	0.00002	0.00519	0.00004	0.00065	0	0.00173	0.00001	0.00353	0.00001
Minke whale	0	0	0	0	0.00093	0.00001	0.00317	0.00002	0	0	0	0
Humpback whale	0	0	0	0	0.00491	0.00004	0	0	0.00491	0.00004	0.01001	0.00004
Northern right whale	0	0	0	0	0.00026	0	0	0	0.00026	0	0.00053	0
Odontocetes												
Sperm whale	0.00007	0	0.00007	0	0.00017	0	0.00006	0	0.00004	0	0.00004	0
Dwarf & Pygmy sperm whales	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier’s beaked whales	0	0	0	0	0.00001	0	0	0	0	0	0	0
Beaked whales	0	0	0	0	0	0	0	0	0	0	0	0
Northern bottlenose whale	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales	0.00004	0	0.00004	0	0.00025	0.00001	0.00042	0.00001	0.00092	0.00003	0.00093	0.00003
Risso’s dolphin	0.00011	0	0.00011	0	0.00036	0.00001	0.00045	0.00001	0.00039	0.00001	0.00040	0.00001
Common dolphin	0.00148	0.00004	0.00150	0.00004	0.00115	0.00003	0.00028	0.00001	0.00028	0.00001	0.00028	0.00001
Bottlenose dolphin	0.00011	0	0.00011	0	0.00056	0.00002	0.00070	0.00002	0.00067	0.00002	0.00068	0.00002
White-sided dolphin	0.00014	0	0.00014	0	0	0	0	0	0	0	0	0
Striped dolphin	0.00027	0.00001	0.00028	0.00001	0.00112	0.00003	0.00112	0.00003	0.00095	0.00003	0.00096	0.00003
Atlantic spotted dolphin	0	0	0	0	0.00004	0	0.00005	0	0.00003	0	0.00003	0
Spinner Dolphin	0	0	0	0	0.00001	0	0	0	0	0	0	0
Harbor porpoise	0	0	0	0	0.00009	0	0	0	0.00009	0	0.00009	0
Pinnipeds												
Harbor seal	0	0	0.00098	0	0	0	0	0	0	0	0	0

NOTES: Number of animals affected for a single transmission is calculated by multiplying the animal density from Table 3-27 by the area of the appropriate zone of influence for that species in Table 3-28.

3.6.2.3 Ex-USS Salmon Site

A qualitative assessment of the presence of marine animals was previously given in Section 3.6.1.3. A quantitative estimate of animal densities in the vicinity of the Ex-USS *Salmon* site can also be made (Table 3-30). Except for blue whale, humpback whale, northern right whale, dwarf and pygmy sperm whales, and harbor seal, the abundances listed in Table 3-30 are from the CeTAP surveys (Kenney et al., 1997). Additional species that were not identified during CeTAP were included in this analysis based on known distribution patterns (Waring et al., 1998). Blue whales and harbor seals are found in temperate to subpolar waters, with seasonal migrations to mid-latitudes. Northern right whales and humpback whales are known to migrate from low latitude breeding grounds to high latitude feeding grounds. While it is known that northern right whales migrate primarily inshore of the shelf edge, it is believed that humpback whales predominantly migrate far offshore. Finally, dwarf and pygmy sperm whales have recently been identified as separate species, but are still difficult to distinguish while surveying at sea. However, it is believed that dwarf and pygmy sperm whales are found worldwide in temperate to tropical waters in small densities (Mullin, 1998).

The abundance estimates from the stock assessment reports were normalized to the same area sampled during the CeTAP surveys. During CeTAP, the entire SNE from the shoreline to the 2000-m (6562 ft) isobath was surveyed (20,236 nm^2 (69,410 km^2)). In Table 3-30, densities, as seen in the right columns, were calculated by dividing the abundances in the left columns by the survey area. The species that are marked by the following symbol (^) are typically found inshore of the shelf edge, and therefore inshore of the test site. Similarly, the species that are marked by the following symbol (*) are typically found offshore of the shelf edge, and therefore offshore of the test site. The densities of these species were reduced by 75 percent of the value listed in Table 3-30 to account for their low densities at the shelf edge before estimates of the number of animals potentially affected by a single transmission (Table 3-32) were calculated.

A sample calculation follows. A total of 305 beaked whales were counted in the SNE in summer during CeTAP. Therefore, the raw density of beaked whales in the SNE (area surveyed was 20,236 nm^2) is 0.0151 animals/nm^2. The ZOI for potential behavioral reactions of odontocetes in the Ex-USS *Salmon* site in the summer for a shallow source is 0.03 nm, which equates to an area around the source of 0.002827 nm^2. The density of beaked whales is then adjusted for their offshore distribution pattern (0.0151 animals/nm^2 / 4) = 0.003775 animals/nm^2, and then multiplied by the ZOI area (0.003775 animals/nm^2 X 0.002827 nm^2) resulting in 0.00001 beaked whales potentially affected by ALFS.

Table 3-30:
Animal Density Near the Ex-USS *Salmon* Site

Species	Abundance[1]				Density: 1998 NMFS survey[2]	Density[3] (animals/sq. nm)			
	Winter	Spring	Summer	Fall		Winter	Spring	Summer	Fall
Mysticetes									
Blue whale	100					0.005	0	0	0
Fin whale ^ [4]	668	794	1759	373		0.033	0.039	0.087	0.018
Minke whale ^	425	3361	0	0		0.021	0.17	0	0
Humpback whale ^	0	1000	0	1000		0	0.049	0	0.049
Northern right whale ^	0	53	0	53		0	0.0026	0	0.0026
Odontocetes									
Sperm whale	33	290	411	0		0.0016	0.014	0.020	0
Dwarf & Pygmy sperm whales					0.0002	0	0	0.0002	0
Cuvier's beaked whales * [5]		14	218			0	0.0007	0.011	0
Beaked whales *	0	111	305	0		0	0.0055	0.0151	0
Pilot whales	955	2973	893	2516		0.047	0.15	0.044	0.12
Risso's dolphin	28	1937	6794	12		0.0014	0.096	0.34	0.0006
Common dolphin	22714	5543	1411	12473		1.12	0.27	0.070	0.62
Bottlenose dolphin	827	4685	3497	333		0.041	0.23	0.17	0.016
White-sided dolphin ^	37	1703	0	4		0.0018	0.084	0	0.0002
Striped dolphin	4554	2571	5203	786		0.23	0.13	0.26	0.039
Atlantic spotted dolphin *	482	901	870	131		0.024	0.045	0.043	0.006
Spinner dolphin *	0	0	128	0		0	0	0.006	0
Harbor porpoise ^	0	2548	0	0		0	0.13	0	0
Pinnipeds									
Harbor seal	100					0.005	0	0	0

Notes:
1. From Kenney et al., 1997; Waring et al., 1998.
2. From Mullin, 1998. Left blank if data provided in previous column.
3. Southern New England area is 20,236 sq. nm.
4. This symbol (^) indicates a species typically found inshore of the test site.
5. This symbol (*) indicates a species typically found offshore of the test site.

Table 3-31 presents the ZOIs for this location during ALFS tests. For the Ex-USS *Salmon* test site in the fall and winter, when the source is located below the axis of the sound channel (i.e., deeper than 61 m (200 ft)), behavioral effects for mysticetes could possibly occur at a distance of 0.35 nm from the source. To incur TTS, mysticetes would have to be within 0.03 nm of the source. Odontocetes and pinnipeds would have to be within 0.03 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS. When the source is above the axis of the sound channel (i.e., shallower than 61 m (200 ft)), behavioral effects for mysticetes could possibly occur at a distance of 0.5 nm from the source. To incur TTS, mysticetes would have to be within 0.03 nm of the source. Odontocetes and pinnipeds would have to be within 0.03 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS.

During the spring and summer at the Ex-USS *Salmon* test site, when the source is located below the axis of the sound channel (i.e., deeper than 30.5 m (100 ft)), potential behavioral effects for mysticetes could possibly occur at a distance of 0.5 nm from the source. To possibly incur TTS, mysticetes would have to be within 0.03 nm of the source. Odontocetes and pinnipeds would have to be within 0.03 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS. When the source is located above the axis of the sound channel (i.e., shallower than 30.5 m (100 ft)), potential behavioral effects for mysticetes could possibly occur at a distance of 0.35 nm from the source. To possibly incur TTS, mysticetes would have to be within 0.03 nm of the source. Odontocetes and pinnipeds would have to be within 0.03 nm of the source to possibly experience behavioral effects, and within 0.005 nm of the source to possibly incur TTS.

Table 3-31:
ZOIs (nm) for ALFS at Ex-USS *Salmon* Proposed Test Site

Ex-USS *Salmon* Site	**Fall/Winter**				**Spring/Summer**			
	Deep Source (> 200 ft)		Shallow Source (< 200 ft)		Deep Source (> 200 ft)		Shallow Source (< 200 ft)	
Species	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**
Mysticetes	0.35	0.03*	0.5	0.03*	0.5	0.03*	0.35	0.03*
Odontocetes	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*
Pinnipeds	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*

* For acoustic environments that did not have a surface duct and did have water depths that supported spherical spreading, the acoustic analysis was conducted using the transmission loss equation for spherical spreading [20 log (R)].

Table 3-32:
Number of Animals Affected for a Single Transmission at the Ex-USS *Salmon* Site

Species	Winter				Spring				Summer				Fall			
	Deep Source		Shallow Source		Deep Source		Shallow Source		Deep Source		Shallow Source		Deep Source		Shallow Source	
	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS
Mysticetes																
Blue whale	0.00192	0.00001	0.00393	0.00001	0	0	0	0	0	0	0	0	0	0	0	0
Fin whale	0.00317	0.00002	0.00648	0.00002	0.00766	0.00003	0.00375	0.00003	0.01708	0.00006	0.00837	0.00006	0.00173	0.00001	0.00353	0.00001
Minke whale	0.00202	0.00001	0.00412	0.00001	0.03338	0.00012	0.01635	0.00012	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0.00962	0.00003	0.00471	0.00003	0	0	0	0	0.00471	0.00003	0.00962	0.00003
Right whale	0	0	0	0	0.00051	0	0.00025	0	0	0	0	0	0.00025	0	0.00051	0
Odontocetes																
Sperm whale	0	0	0	0	0.00004	0	0.00004	0	0.00006	0	0.00006	0	0	0	0	0
Dwarf & Pygmy sperm whales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier’s beaked whales	0	0	0	0	0	0	0	0	0.00001	0	0.00001	0	0	0	0	0
Beaked whales	0	0	0	0	0	0	0	0	0.00001	0	0.00001	0	0	0	0	0
Pilot whales	0.00013	0	0.00013	0	0.00042	0.00001	0.00042	0.00001	0.00012	0	0.00012	0	0.00034	0.00001	0.00034	0.00001
Risso’s dolphin	0	0	0	0	0.00027	0.00001	0.00027	0.00001	0.00095	0.00003	0.00095	0.00003	0	0	0	0
Common dolphin	0.00314	0.00009	0.00314	0.00009	0.00076	0.00002	0.00076	0.00002	0.00020	0.00001	0.00020	0.00001	0.00174	0.00005	0.00174	0.00005
Bottlenose dolphin	0.00011	0	0.00011	0	0.00064	0.00002	0.00064	0.00002	0.00048	0.00001	0.00048	0.00001	0.00004	0	0.00004	0
White-sided dolphin	0.00001	0	0.00001	0	0.00024	0.00001	0.00024	0.00001	0	0	0	0	0	0	0	0
Striped dolphin	0.00064	0.00002	0.00064	0.00002	0.00036	0.00001	0.00036	0.00001	0.00073	0.00002	0.00073	0.00002	0.00011	0	0.00011	0
Atlantic spotted dolphin	0.00002	0	0.00002	0	0.00003	0	0.00003	0	0.00003	0	0.00003	0	0	0	0	0
Spinner Dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harbor porpoise	0	0	0	0	0.00009	0	0.00009	0	0	0	0	0	0	0	0	0
Pinnipeds																
Harbor seal	0.00001	0	0.00001	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTES: Number of animals affected for a single transmission is calculated by multiplying the animal density from Table 3-30 by the area of the respective zone of influence for that species from Table 3-31.

3.6.2.4 MCAS Cherry Point

Transmission and ZOI tables for affected marine animals are not provided since no ALFS or other sonar tests will be conducted at MCAS Cherry Point. Marine species could be affected by SH-60R engine noise if tests occur in the military training ranges located off the coast of MCAS Cherry Point. These effects are described in Section 3.6.2. Information on the physical properties and testing capabilities of the air-to-surface target ranges used by MCAS Cherry Point can be found in Appendix B.

No significant impacts are expected with regard to affected animals at the target ranges (BT-9 on Brant Island Scholl and BT-11 at Piney Island (See Appendix B for more information regarding these ranges)). The BT-9 target range is located in shallower water than the water surrounding the target area. Sea turtles are known to inhabit the deeper waters of Pamlico Sound (U.S. DoN, 1998d). The BT-9 target range is also not a critical habitat for the three turtle species foraging in Pamlico Sound (U.S. DoN, 1998d). The Piney Island range has several Federal or State listed bird species living or nesting in the ranges. However, birds appear to have acclimated to aircraft overflights (U.S. DoN, 1998d). Overflight noise exposure currently at the ranges is not expected to change from implementation of the SH-60R tests.

3.6.3 Summary of Potential Impacts to Marine Biological Resources From Underwater Noise

As an overview of the SH-60R Test Program, it should to pointed out aircraft noise and acoustic source transmissions have the potential to impact the marine environment at the test sites. This potential is due to the span of the test program (25 months for DT and 15 months for OT), multiple test locations, numerous planned acoustics transmission and flight hours, use of multiple sources, and the deployment of those sources at numerous depths. The approach to quantifying this potential impact, in Section 3.6.2, used conservative assumptions at each step of the process. These conservative assumptions included:

- Using the highest attainable source level for each system (this includes both the highest level the system can physically generate and also the use of an assumed omnidirectional source with a source level of it strongest beam),
- Approximating the AN/AQS-13F and AN/SSQ-62 sources by the more powerful ALFS source level,
- Examining the propagation at the test sites for all seasons and using the nominal case (i.e., least propagation loss) values to determine the ZOIs,
- Examining all possible source depths and using the nominal case (i.e., least propagation loss) values to determine the ZOIs,
- Identifying the maximum number of transmissions/flight hours that could be used,
- Utilizing the best available animal population data, and
- Assuming that no mitigation is used.

For each site, the resulting tables (Tables 3-26, 3-29, and 3-32) that identify the possibility of a single transmission affecting a marine mammal are, therefore, conservative estimates.

Additional factors, which will further reduce the potential to impact the marine environment at the test sites and that will significantly reduce the estimates of number of animals potentially affected for a single transmission, include:

- Visual monitoring, and
- Passive acoustic monitoring

The effectiveness of the visual monitoring is estimated to be excellent because the SH-60R makes a very good platform to conduct visual survey. The aircraft's height (i.e., height of observer's eye) above the water, its ability to hover in place, and its nearly 100 percent unobstructed view ensure excellent viewing of the surrounding water. Additionally, all of the tests that include acoustic transmissions are planned to occur during the day.

The possibility exists that a deep diving animal or an animal that has been submerged for a long period of time, and therefore not available for visual observation, surfaces in a ZOI. Animals with this type of behavior are typically the large odontocetes, whose ZOIs are 457 m (500 yards) or less. Additionally, this possibility is minimized by the greater visual-observation ranges that are available to the SH-60R aircraft. Effectively, most animals will have numerous opportunities to be spotted prior to their approaching the ZOIs. Also, the mobility of the aircraft allows it to easily move away from most approaching animals or areas with animal activity (i.e., feeding or mating sites).

Therefore, in summary, the effectiveness of the mitigation measures, combined with the small ZOIs (especially for the odontocetes and pinnipeds) and the low-duty cycles for the sonar sources, make the possibility that an endangered or threatened marine mammal could be in the ZOI for any active sonar negligible. It is the intent of the SH-60R Test Program to implement these mitigation measures to minimize any marine mammal from entering the ZOI of an active sonar, or to suspend transmissions from that sonar until the marine mammal has departed from the ZOI. Therefore, there would be no effect to either individual or cumulative threatened or endangered biological resources as a result of the Proposed Action, and no harassment as defined under the MMPA.

3.6.4 Marine Mammal Collision and Entanglement Possibilities

The dipping sonars are designed to be lowered from a hovering (i.e., nearly stationary) helicopter. If a collision were to occur, the only contribution to the collision velocity would be the animal's speed. Therefore, the sonars do not constitute any significant collision hazard to marine mammals or sea turtles.

While the probability of occurrence is negligible, there is a remote potential for entanglement of marine mammals with the dipping sonar's cable. The cable that connects the transducer to the helicopter is flexible so that it can be reeled in. However, the weight of the transducer on the cable will keep it taut, preventing any loops in which an animal could become entangled.

The AN/SSQ-62 sonobuoy also has a slight, but remote, potential to entangle marine animals. Although the majority of the components, including aluminum, steel, plastic, electronic wires and the battery, are negatively buoyant, for the six to eight hours (maximum) that the sonobuoy is operational, the wire connecting the transducer to the float is suspended in the water column. At the completion of operation, or on command, this float scuttles and all of the components drop to the ocean floor. Since a loop is not present in the wire while the sonobuoy is operational, the probability that any animal could be entangled is negligible.

4. MITIGATION MEASURES

4.1 Visual Observations

Individuals (i.e., pilots, spotters, or other test participants) that have been trained by the Navy, Coast Guard, and/or other qualified organizations in marine mammal identification will conduct visual monitoring of marine mammals from the helicopter. Visual monitoring will occur as the helicopter nears the test site and will continue as the transducer is lowered to its selected depth. This process will take at least 10 minutes, allowing sufficient time to determine if the most common species of animals are present prior to active transmissions. The SH-60R conducts operations at a given location on the order of tens of minutes, and while the SH-60R is performing the tests, the chase aircraft will maintain watch at a higher altitude, thereby ensuring complete coverage of the ZOIs (See Table 4-1).

Table 4-1:
ZOIs (nm) for ALFS at Proposed Test Sites

NAS PRC	**Year Round**							
Species	**Behavior**				**TTS**			
Mysticetes	0.5				0.03*			
Odontocetes	0.03*				0.005 *			
Pinnipeds	0.03*				0.005 *			
AWA	**Fall/Winter**				**Spring/Summer**			
	Deep Source (> 400 ft)		Shallow Source (< 400 ft)		All Source Depths			
Species	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**		**TTS**	
Mysticetes	0.35	0.03*	0.5	0.03*	0.35		0.03*	
Odontocetes	0.03*	0.005*	0.03*	0.005*	0.03*		0.005*	
Pinnipeds	0.03*	0.005*	0.03*	0.005*	0.03*		0.005*	
Ex-USS *Salmon* Site	**Fall/Winter**				**Spring/Summer**			
	Deep Source (> 200 ft)		Shallow Source (< 200 ft)		Deep Source (> 100 ft)		Shallow Source (< 100 ft)	
Species	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**	**Behavior**	**TTS**
Mysticetes	0.35	0.03*	0.5	0.03*	0.5	0.03*	0.35	0.03*
Odontocetes	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*
Pinnipeds	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*	0.03*	0.005*

* For acoustic environments that did not have a surface duct but did have water depths that supported spherical spreading, the acoustic analysis was conducted using the transmission loss equation for spherical spreading [20 log (R)].

If marine mammals are visually identified within the ZOIs, the ALFS will not begin transmitting until the animal(s) have left the area. If an animal is seen during active transmissions and the animal enters the ZOI, active transmissions will be suspended until the animal leaves the area. Inclement weather is not expected to influence the visual observation since the observer should be able to at least see an animal (but possibly have difficulty identifying it) and because the ZOIs are so small. In addition, there will be weather restrictions regarding ALFS testing during the fall of 1999. Because of the possibility of system failures/emergencies, the weather ceiling will have to be 500 ft above the maximum depth of sonar deployment (i.e., if the sonar is lowered to 500 ft, the weather ceiling will have to be 1,000 ft). ALFS will not be tested at night.

4.2 Passive Acoustic Monitoring

Passive acoustic monitoring will occur simultaneously with visual monitoring. Passive acoustic monitoring can provide an indicator of the presence of vocalizing marine mammals in proximity to the active sonars. The transducer will be used in a passive mode prior to initiating active transmissions, while continuous monitoring will occur with deployed sonobuoys prior to and during transmissions. If marine mammals are detected, visual observers will be cued to the estimated location of the vocalizations, and the shut-down procedures cited in Section 4.1 will apply.

4.3 Effectiveness of Mitigation Measures

All operations during DT and OT occur during the daytime and in relatively good weather. Operations typically occur at a given location on the order of tens of minutes. With the additional time required for the SH-60R to stabilize and raise and/or lower ALFS, the time at a given location is sufficient to determine if the most common species of animals are present. The proposed mitigation measures are estimated to be extremely effective at reducing the estimated takes because of the following conditions:

- Observations will occur from a helicopter,
- Passive acoustics will be used to cue visual observers to submerged mammals,
- The ZOIs are very small,
- Only testing during daytime,
- Low sea states for operations, and
- Multiple helicopters (source helicopter and chase aircraft) during testing.

When the mitigation measures are applied and the estimated takes are adjusted for the effectiveness of the mitigation (Tables 4-2, 4-3 and 4-4), the Proposed Action would have a negligible effect.

**Table 4-2:
Number of Animals Potentially Affected for a Single Transmission
in the CTR with Mitigation Measures**

Species	Winter		Spring		Summer		Fall	
	Beh.	**TTS**	**Beh.**	**TTS**	**Beh.**	**TTS**	**Beh.**	**TTS**
Mysticetes								
Fin whale	0	0	0	0	0	0	0	0
Minke whale	0	0	0	0	0	0	0	0
Humpback whale	0.00017	0.00001	0	0	0	0	0	0
Odontocetes								
Bottlenose dolphin – coastal stock	0	0	0.00001	0	0.00002	0	0	0
Harbor porpoise	0.00003	0	0	0	0	0	0	0
Pinnipeds								
Harbor seal	0	0	0	0	0	0	0	0

NOTES: Number of animals affected for a single transmission is calculated by adjusting the total number of animals affected from Table 3-24 by the area of the appropriate zone of influence and the effectiveness of the mitigation measures.

Table 4-3: Number of Animals Potentially Affected for a Single Transmission in the AWA with Mitigation Measures

Species	Winter				Spring		Summer		Fall			
	Deep Source		Shallow Source		All Sources		All Sources		Deep Source		Shallow Source	
	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS
Mysticetes												
Blue whale	0.00001	0	0.00002	0	0	0	0	0	0	0	0	0
Fin whale	0.00003	0	0.00005	0	0.00005	0	0.00001	0	0.00002	0	0.00004	0
Minke whale	0	0	0	0	0.00001	0	0.00003	0	0	0	0	0
Humpback whale	0	0	0	0	0.00005	0	0	0	0.00005	0	0.00010	0
Northern right whale	0	0	0	0	0	0	0	0	0	0	0.00001	0
Odontocetes												
Sperm whale	0	0	0	0	0	0	0	0	0	0	0	0
Dwarf & Pygmy sperm whales	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier's beaked whales	0	0	0	0	0	0	0	0	0	0	0	0
Beaked whales	0	0	0	0	0	0	0	0	0	0	0	0
Northern bottlenose whale	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales	0	0	0	0	0	0	0	0	0.00001	0	0.00001	0
Risso's dolphin	0	0	0	0	0	0	0	0	0	0	0	0
Common dolphin	0.00001	0	0.00001	0	0.00001	0	0	0	0	0	0	0
Bottlenose dolphin	0	0	0	0	0.00001	0	0.00001	0	0.00001	0	0.00001	0
White-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0
Striped dolphin	0	0	0	0	0.00001	0	0.00001	0	0.00001	0	0.00001	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0
Spinner Dolphin	0	0	0	0	0	0	0	0	0	0	0	0
Harbor porpoise	0	0	0	0	0	0	0	0	0	0	0	0
Pinnipeds												
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0

NOTES: 1. Number of animals affected for a single transmission is calculated by adjusting the total number of animals affected from Table 3-27 by the area of the appropriate zone of influence and the effectiveness of mitigation measures.

Table 4-4:
Number of Animals Potentially Affected for a Single Transmission at the Ex-USS *Salmon* Test Site with Mitigation Measures

Species	**Winter**				**Spring**				**Summer**				**Fall**			
	Deep Source		Shallow Source		Deep Source		Shallow Source		Deep Source		Shallow Source		Deep Source		Shallow Source	
	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS	Beh.	TTS
Mysticetes																
Blue whale	0.00002	0	0.00004	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin whale	0.00003	0	0.00006	0	0.00008	0	0.00004	0	0.00017	0	0.00008	0	0.00002	0	0.00004	0
Minke whale	0.00002	0	0.00004	0	0.00033	0	0.00016	0	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0.00010	0	0.00005	0	0	0	0	0	0.00005	0	0.00010	0
Right whale	0	0	0	0	0.00001	0	0	0	0	0	0	0	0	0	0.00001	0
Odontocetes																
Sperm whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dwarf & Pygmy sperm whales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier's beaked whales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaked whales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0	0	0.00001	0	0.00001	0	0	0	0	0
Common dolphin	0.00003	0	0.00003	0	0.00001	0	0.00001	0	0	0	0	0	0.00002	0	0.00002	0
Bottlenose dolphin	0	0	0	0	0.00001	0	0.00001	0	0	0	0	0	0	0	0	0
White-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striped dolphin	0.00001	0	0.00001	0	0	0	0	0	0.00001	0	0.00001	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spinner Dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harbor porpoise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pinnipeds																
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTES: 1. Number of animals affected for a single transmission is calculated by adjusting the total number of animals affected from Table 3-30 by the area of the appropriate zone of influence and the effectiveness of mitigation measures.

4.4 Potential for Multiple Pings on an Animal

In order to estimate the number of pings that an individual animal may potentially receive, it is necessary to examine the expected test scenarios. Planned ALFS testing would occur in two contexts: a transducer test scenario and an ASW mission profile scenario. For a transducer test, the source would be lowered into the water to a predetermined depth and pinged for a given period of time with a duty-cycle less than or equal to 10 percent.

ASW mission profile flights are divided into a search and track phase. During the search phase, the transducer would be lowered and approximately five transmissions would occur at varying depths. The helicopter would then retract ALFS and proceed to a new location in the same general area. This evolution would continue at an average rate of 6 dips per hour. In the tracking mode, there would be approximately 20 pings per dip and 6 dips per hour. Typically during ASW mission profile flights, two-thirds of the time is spent searching and one-third is spent tracking.

For each helicopter relocation, if mammals were in the vicinity, most likely a different set of mammals would be exposed. The mitigation measures (described in detail in Sections 4.1 and 4.2) would be applied continuously prior to and during any active transmissions. Since the ZOIs are very small, it is highly likely that any mammals in the vicinity of the source would be detected prior to the source transmitting. Furthermore, the most common species are short-duration, shallow divers that are found in multiple animal pods, and these species would be easily detected visually. As unlikely as it is that an animal would receive one ping (see Tables 4-2, 4-3, and 4-4), the probability that an animal would remain undetected and receive more than one ping is negligible.

However, to address the very remote possibility that an animal does remain undetected, the following discussion estimates the potential for multiple pings on an animal. As mentioned above, the transducer test scenario would have a maximum of less than 360 transmissions per hour in any one location (assuming a typical one-second transmission); while during the ASW mission profile scenario, there would be a maximum of less than 5 or 20 transmissions per location for the search or track phases, respectively. In the transducer test scenario, since the source would not be moving, the limiting factor is the time it takes an animal to transit the ZOI (assuming an average swim speed of 3 knots for all animals) or the average time until the animal surfaces and can be visually observed, thereby suspending transmissions. For the ASW mission profile scenario, the limiting factor is the smallest of the following: the time it takes an animal to transit the ZOI (assuming an average swim speed of 3 knots for all animals); the maximum number of transmissions at that location; or the average time until the animal surfaces and can be visually observed, thereby suspending transmissions.

For the transducer test scenario, the limiting factor for mysticetes and small odontocetes is the average dive time of the animal, while for large odontocetes it is the time required to transit the ZOI. Mysticetes could potentially receive a maximum of 18 pings, large odontocetes could potentially receive a maximum of 12 pings, and small odontocetes could potentially receive a maximum of 3 pings.

For the search phase of the ASW mission profile scenario, the limiting factor for mysticetes, large odontocetes, and small odontocetes is the maximum number of transmissions at that location. Mysticetes, large odontocetes, and small odontocetes could potentially receive a maximum of 5 pings before the source moves to a new location.

For the track phase of the ASW mission profile scenario, the limiting factor for mysticetes and large odontocetes is the maximum number of transmissions at that location. The limiting factor for small odontocetes is the average time until the animal surfaces and can be observed. Mysticetes could potentially receive a maximum of 20 pings, large odontocetes could potentially receive a maximum of 12 pings, and small odontocetes could potentially receive a maximum of 6 pings.

Utilizing an equal energy approach, the resulting maximum reduction in received levels for behavioral modification and TTS can be approximated by 10 log (N) where N is the number of transmissions an animal receives. Considering the above cases, the mysticete levels can be reduced by 13 dB while the odontocete levels can be reduced by 10.8 dB. As a result, the mysticete ZOI for behavior increases by a factor of 3, while the odontocete ZOI increases by a factor of 2. This increases the area of the ZOI by a factor of 9 and 4, respectively, for mysticetes and odontocetes (since area is calculated as the square of the radius). When these correction values are applied to the tables displaying the number of animals affected by a single transmission (without mitigation; see Tables 3-26, 3-29, and 3-32), there is no significant effect.

Additionally, for the ASW mission profile scenario, a very low probability exists of the helicopter relocating to the same area as the transiting animal. For the mysticetes, the combination of their ZOIs and the typical distances between dip sites results in a less than 10 percent chance of this occurring. For the odontocetes, with their smaller ZOIs, this probability is less than 3 percent. Again, it should be reiterated that test personnel would be following the proposed mitigation measures, which should reduce the possibility of any animal coming within the ZOIs to a negligible level.

4.5 Estimated Total Effect of DT/OT

DT is scheduled to occur over the span of 25 months, while OT is scheduled to occur over 15 months. There are approximately 20 flights planned for DT and OT while operating the ALFS transducer in the CTR, the AWA, and at the Ex-USS *Salmon* site. The total number of transmissions during the entire testing cycle is difficult to predict. Table 4-5 reflects the best estimates of the number of transmissions for each of the sonar sources at each of the planned test areas on an averaged flight basis.

Table 4-5:
Average Number of Transmissions During a Typical Flight

Location	**Typical Number of Transmissions/Flight**		
	ALFS	AN/AQS-13F	AN/SSQ-62
CTR	270	No planned use	No planned use
AWA	427	No planned use	300
Ex-USS *Salmon* site	180	120	300

Because of the limited testing of the systems over long-term time scales and the following fluctuating variables, it is only appropriate to evaluate any overall effect as a function of a single flight:

- Different animals located in the same area on different days,
- Different systems being tested,
- Varying duration of testing on an individual day,
- Different signals being tested,
- Testing at various depths in the water column.

As described in detail in Section 3.6 and this section, no effects are expected on individual animals or animal populations. Therefore, there would be no cumulative effect over the span of DT/OT.

5. CUMULATIVE IMPACTS

The CEQ's implementing regulations for NEPA define cumulative impacts as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (40 CFR 1508.7).

A determination of cumulative impacts involves the consideration of both the affected environment as well as the environmental consequences of the connected actions. There are no expected impacts to Geology and Soils, Land Use, Utilities, Transportation, Aircraft Operations and Safety, Cultural Resources, and Environmental Justice. Other environmental resources (air quality, water quality, noise, socioeconomics, and coastal zone management) affected by the implementation of the Proposed Action result in minor to negligible impacts based on the EA/OEA analysis.

Since there are no effects on marine animals from the Proposed Action, the Proposed Action is not expected to have any significant cumulative effects on marine species, which is further amplified by the following:

- The ALFS system would operate at a very low-duty cycle (only on maximum 10 percent of the time) at very short pulse lengths (mostly/only 1 s, maximum of 9 s), and for very short periods of time in any given area. Even if considered in combination with other underwater acoustic effects, such as commercial shipping, other operational, research, and exploration activities, recreational water activities, and naturally-occurring sounds (e.g., storms, lightning strikes, subsea earthquakes, marine mammal vocalizations, etc.), ALFS underwater acoustic transmissions would not appreciably add to the number of acoustic events to which marine mammal species are exposed.
- The ALFS system would not be stationary.
- The ALFS system would be operated for only brief periods of time on an annual basis (estimated maximum of 36.5 minutes of active pinging per year).
- A maximum of only one ALFS system would be undergoing underwater testing at any one time.

The ALFS would not be operated in the vicinity of other research or exploration activities or noise sources in the same frequency regime because the noise from such activities would be detrimental to the successful conduct of ALFS testing operations.

Based on information gathered during preparation of the EA/OEA, the Navy finds that the SH-60R/ALFS Test Program at NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point will not significantly affect the environment. In accordance with EO 12114, *Environmental Effects Abroad of Major Federal Actions*, and based on information gathered during preparation of the EA/OEA, the Department of the Navy finds that the SH-60R/ALFS Test Program at NAS PRC, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point will not result in significant harm to resources of the global commons.

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6. BIBLIOGRAPHY

16 USC 470, et seq. 1966. National Historic Preservation Act of 1966, as amended. October 30, 1992.

16 USC 1361, et seq. 1972. National Marine Mammal Protection Act.

16 USC 1531, et seq. 1973. Endangered Species Act.

25 USC 3005, et seq. 1990. Native American Graves Protection and Repatriation Act. November 16, 1990.

32 CFR 775, et seq. 1998. Procedures for Implementing the National Environmental Policy Act. National Defense, Department of the Navy. July 1, 1998 (revised).

40 CFR 51.850-860. 1993. Determining Conformity of General Federal Actions to State or Federal Implementation Plans. Protection of the Environment, Requirements for Preparation, Adoption, and Submittal of Implementation Plans. November 30, 1993.

40 CFR 1500, et seq. 1998. Purpose, Policy, and Mandate. Protection of the Environment, Council on Environmental Quality. July 1, 1998 (revised).

42 USC 4321, et seq. 1969. National Environmental Policy Act.

42 USC 4901-4918. 1972. Noise Control Act (as amended). The Public Health and Welfare, Noise Control.

Acevedo-Gutierrez, A. and S. Burkhart. 1998. Seasonal distribution of bottlenose (*Tursiops truncatus*) and pantropical spotted (*Stenella attenuata*) dolphins in Golfo Dulce, Costa Rica. Rev. Biol. Trop. 46, Suppl. 6: 1-11.

Agler, B. A., R. L. Schooley, S. E. Frohock, S. K. Katona, and I. E. Seipt. 1993. Reproduction of photographically identified fin whales (*Balaenoptera physalus*) from the Gulf of Maine. J. Mammal. 74: 577-587.

Au, W. W. L. 1993. *The Sonar of Dolphins*. Springer-Verlag. New York. 277 p.

Au, W. W. L. 1997. Echolocation in dolphins with a dolphin-bat comparison. Bioacoustics. 8: 137-162.

Au, W. W. L., P. E. Nachtigall, and J. L. Pawloski. 1997. Acoustic effects of ATOC signals (75 Hz, 195 dB) on dolphins and whales. J. Acous. Soc. Am. 101: 2973-2977.

Au, W. W. L., D. L. Herzing, and R. Aubauer. 1998. Real-time measurement of the echolocation signals of wild dolphins using a 4-hydrophone array. Abstracts of the World Marine Mammal Science Conference, Monaco. January, 1998.

Barco, S. G., W. M. Swingle, W. A. McLellan, R. N. Harris, and D. A. Pabst. 1999. Local abundance and distribution of bottlenose dolphins (*Tursiops truncatus*) in the nearshore waters of Virginia Beach, Virginia. Marine Mammal Science. 15(2): 394-408.

Bjorndal, K. A. 1997. Foraging ecology and nutrition in sea turtles. In: Lutz, P. L. and J. A. Musick (eds.). The Biology of Sea Turtles. CRC Press, Inc. New York. 415 p.

Blaylock, R. A., J. W. Hain, L. Hansen, D. L. Palka, and G. T. Waring. 1995. U. S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. NOAA Tech. Mem. SEFSC-363. 211 p.

Block, R.M., and S.C. Schiff. 1977. Effects of Aluminized Fiberglass on Representative Chesapeake Bay Marine Organisms. Naval Research Laboratory. 133 p.

Braham, H. W. 1983. Northern records of Risso’s dolphins, *Grampus griseus*, in the Northeast Pacific. Canadian Field-Naturalist. 97: 89-90.

Busnel, R-G and A. Dziedzic. 1966. Acoustic signals of the pilot whale *Globicephala melaena* and of the porpoises *Delphinus delphis* and *Phocoena phocoena*. In: Norris, K. S. (ed.). Whales, dolphins, and porpoises. Proceedings of the International Symposium on Cetacean Research. University of California Press. Berkeley, CA. 789 p.

Busnel, R-G, G. Pilleri, and F. C. Fraser. 1968. Notes concernanat le dauphin *Stenella styx* (Gray, 1846). Mammalia. 32: 192-203.

Caldwell, D. K. and M. C. Caldwell. 1971. Underwater pulsed sounds produced by captive spotted dolphins, *Stenella plagiodon*. Cetology. 1: 1-7.

Caldwell, M. C. and D. K. Caldwell. 1968. Vocalization of naïve captive dolphins in small groups. Science. 159: 1121-1123.

Caldwell, M. C. and D. K. Caldwell. 1969. Simultaneous but different narrow-band sound emissions by a captive eastern Pacific pilot whale, *Globicephala scammoni*. Mammalia. 33: 505-508 + plates.

Caldwell, M. C., D. K. Caldwell, and J. F. Miller. 1973. Statistical evidence for individual signature whistles in the spotted dolphin, *Stenella plagiodon*. Cetology. 16 1-21.

Caldwell, M. C., D. K. Caldwell, and P. Tyack. 1990. Review of the signature-whistle hypothesis for the Atlantic bottlenose dolphin. In: Leatherwood S. and R. R. Reeves (eds.). The Bottlenose Dolphin. Academic Press. San Diego, CA. 653 p.

Carder, D., S. Ridgway, B. Whitaker, and J. Geraci. 1995. Hearing and echolocation in a pygmy sperm whale *Kogia.* Abstracts of the 11th Biennial Conference on the Biology of Marine Mammals, Orlando, FL. December, 1995.

Carlstrom, J., J. Denkinger, P. Feddersen, and N. Oien. 1997. Record of a new northern range of Sowerby’s beaked whale (*Mesoplodon bidens*). Polar Biol. 17: 459-461.

Cetacean and Turtle Assessment Program (CeTAP). 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48. Bureau of Land Management, Washington, DC 538 pp.

Chesapeake Bay Program. 1998. Information from Internet web site. http://cobia.chesapeakebay.net/water_quality/station_main.cfm.

Christensen, I., T. Haug, and N. Oien. 1992. A review of feeding and reproduction in large baleen whales (Mysticet*i*) and sperm whales (*Physeter macrocephalus*) in Norwegian and adjacent waters. Fauna Norvegica Series A. 13: 39-48.

Clapham, P. J., L. Baraff, C. Carlson, M. Christian, D. K. Mattila, C. Mayo, M. Murphey, and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales in the southern Gulf of Maine. Can. J. Zool. 71: 440-443.

Clark, C. W. and R. Charif. 1998. Monitoring the occurrence of large whales off North and West Scotland using passive acoustic arrays. Society of Petroleum Engineers (SPE). SPE/UKOOA European Environmental Conference, Aberdeen, Scotland. April, 1998.

Clarke, M. R. 1976. Observation on sperm whale diving. J. Mar. Biol. Assoc. UK. 56: 809-810.

Clarke, R. 1956. Marking whales from a helicopter. Norsk Hvalfangst-Tid. 45(6): 311-318.

Continental Shelf Associates, Inc (Continental). 1997. Final Environmental Review for the Adoption of a Range Management Plan for the Atlantic Undersea Test and Evaluation Center (AUTEC), Andros Island, Bahamas. Prepared for the Naval Undersea Warfare Center Detachment AUTEC.

County of Inyo. 1996. Emissions by Category: 1996 Estimated Annual Average Emissions, Inyo County.

Croll, D. A., B. R. Tershy, R. P. Hewitt, D. A. Demer, P. C. Fiedler, S. E. Smith, W. Armstrong, J. M. Popp, T. Kiekhefer, V. R. Lopez, J. Urban, and D. Gendron. 1998. An integrated approach to the foraging ecology of marine birds and mammals. Deep-Sea Research II. 45: 1353-1371.

Croll, D. A., B. R. Tershy, A. Acevedo, and P. Levin. 1999. Marine vertebrates and low frequency sound. Technical Report for SURTASS LFA EIS. Marine Mammal and Seabird Ecology Group, Institute of Marine Sciences, University of California, Santa Cruz.

D'Vincent, C. G., R. M. Nilson, and R. E. Hanna. 1985. Vocalization and coordinated feeding behavior of the humpback whale in southeastern Alaska. Sci. Rep. Whales Res. Inst. 36: 41-47.

Dodd, K.C., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle *Cretta caretta* (Linnaeus 1758). FAO Synopsis NMFS-149. U.S. Fish and Wildlife Service Biological Report 88(14). U.S. Fish and Wildlife Service, Gainesville, Florida.

Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-1983: Status, abundance, and distribution. Part of Investigator's Final Report, Marine Mammal and Seabird Study, Central and Northern California. Report Contract No. 14-12-0001-29090 from Center for Marine Studies, University of California at Santa Cruz, for U. S. Minerals Management Service, Los Angeles, USA. 284 p.

Eagle Systems Inc. 1995. Analysis of Electronic Warfare Digest, Vol. 17 No. 4, April 1994, *Exclusive Report: Chaff Potentially Harmful to the Environment, Studies Say*. 22 p. Prepared for Naval Research Laboratory.

Eckert, S. A., P. Ponganis, and G. L. Kooyman. 1989. Diving and foraging behavior of leatherback sea turtles *Dermochelys coriacea*. Can. J. Zool. 67: 2834-2840.

Edds, P. L. 1988. Characteristics of finback *Balaenoptera physalus* vocalizations in the St. Lawrence Estuary. Bioacoustics. 1: 131-149.

Executive Order (EO) 12114. 1979. *Environmental Effects Abroad of Major Federal Actions.* January 4, 1979.

Executive Order (EO) 12898. 1994. *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. February 11, 1994.

Ernst, C. H., R. W. Barbour, and J. E. Lovich. 1994. *Turtles of the United States and Canada*, 2nd edition. Smithsonian Institution Press. Washington, D.C. 578 p.

Evans, P. G. H. 1987. *The Natural History of Whales and Dolphins*. Great Britain. 343 p.

Evans, W. E. 1994. Common dolphin, white-bellied porpoise *Delphinus delphis* (Linnaeus, 1758). In: Ridgway, S. H. and R. Harrison (eds.). Handbook of Marine Mammals, Vol. 5: The first book of dolphins. Academic Press, New York. 416 p.

Fish, J. F. and C. W. Turl. 1976. Acoustic source levels of four species of small whales. U.S. Naval Undersea Center, San Diego, California.

Frost, K. J. and L. F. Lowry. 1993. Assessment of damages to harbor seals caused by the *Exxon Valdez* oil spill. p. 300-302. In: *Exxon Valdez* oil spill symposium/Abstract book, Anchorage, AK, Feb. 1993. *Exxon Valdez* Oil Spill Trustee Council, University of Alaska Sea Grant College Program, and American Fisheries Society Alaska Chapter, Anchorage, AK.

General Electric, Inc. 1997. Memorandum to Chris Jaufmann, ICF Incorporated from PC Johnston, Manager, GE Aircraft Engines. May 29, 1997. 24 p.

Gordon, J. C. D. 1987. Behaviour and ecology of sperm whales off Sri Lanka. Ph.D. dissertation, University of Cambridge, England.

Haley, M.V. and C.W. Kurnas. 1993. Aquatic toxicity and fate of nickel coated graphite fibers, with comparisons to iron and aluminum coated glass fibers. U.S. Army Chemical and Biological Defense Agency. 19 p.

Heyning, J. E. 1989. Cuvier’s beaked whale *Ziphius cavirostris* (G. Cuvier, 1823). In: Ridgway, S. H. and R. Harrison (eds.). Handbook of Marine Mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, New York. 442 p.

Hill, R. D. 1985. Investigation of lightning strikes to water surfaces. J. Acoust. Soc. Am. 78(6): 2096-2099.

Holmes, E. and L. Gainey. 19991. Software Requirements Specifications for the Parabolic Equation Model, Version 3.3. September 10, 1991.

Hooker, S. K. and H. Whitehead. 1998. Echolocation of northern bottlenose whales – an analysis of click characteristics and their implications for foraging. Abstracts of the World Marine Mammal Science Conference, Monaco. January 1998.

Hoover, A. A. 1988. Harbor seal *Phoca vitulina*. p. 125-157. In: J. W. Lentfer (ed.), Selected marine mammals of Alaska/Species account with research and management recommendations. U. S. Marine Mammal Commission, Washington, D.C. 275 p. NTIS PB88-178462.

Houston, J. 1991. Status of Cuvier’s beaked whale, *Ziphius cavirostris*, in Canada. Can. Field-Nat. 105:215-218.

Jefferson, T. A. 1995. Distribution, abundance, and some aspects of the biology of cetaceans in the offshore Gulf of Mexico. Ph.D. dissertation, Texas A&M University.

Jefferson, T.A., S. Leatherwood and M.A. Webber. 1993. Marine mammals of the world-FAO species identification guide. Food and Agriculture Organization of the United Nations, Rome. 320pp.

Johnson, C. S. 1967. Sound detection thresholds in marine mammals. In: Tavolga, W. N. (ed.). Marine Bio-acoustics. Vol. 2. pp. 247-260. Pergammon Press, Oxford.

Johnson, S. R., J. J. Burns, C. I. Malme, and R. A. Davis. 1989. Synthesis of information on the effects of noise and disturbance on major haulout concentrations of Bering Sea pinnipeds. OCS Study MMS 88-0092. Rep. from LGL Alaska Res. Assoc. Inc., Anchorae, AK, for U. S. Minerals Management Service, Anchorage, AK. 267 p. NTIS PB89-191373.

Kellog, R. 1931. Whaling statistics for the Pacific coast of North America. J. Mammal. 12: 73-77.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. In: Leatherwood, S. and R. R. Reeves (eds.). The Bottlenose Dolphin. pp. 369-386. Academic Press, San Diego, USA.

Kenney, R. D., G. P. Scott, T. J. Thompson, H. E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. J. Northw. Atl. Fish. Sci. 22: 155-171.

Ketten, D. R. 1992. The cetacean ear: Form, frequency, and evolution. In: Thomas, J. A., R. A. Kastelein, and A. Y. Supin (eds.). Marine Mammal Sensory Systems. Plenum Press, New York. 773 p.

Ketten, D. R. 1994. Functional analyses of whale ears: Adaptations for underwater hearing. IEEE Proc. Underwater Acous. 1: 264-270.

Kinsler, L. E., A.R. Frey, A.B. Coppens, and J.V. Sanders. 1982. *Fundamentals of Acoustics.* Third Edition. John Wiley & Sons, Inc. New York. 480 p.

Kruse, S. L. 1989. Aspects of the biology, ecology, and behavior of Risso's dolphins (*Grampus griseus*) off the California coast. M.S. thesis, University of California, Santa Cruz.

Leatherwood, S. and R. R. Reeves. 1983. *The Sierra Club Handbook of Whales and Dolphins*. Sierra Club Books. San Francisco.

Leatherwood, S., W. F. Perrin, V. L. Kirby, C. I. Hubbs, and M. Dahlheim. 1980. Distribution and movements of Risso's dolphin, *Grampus griseus*, in the eastern North Pacific. Fishery Bulletin US. 77: 951-963.

Lenhardt, M. L. 1994. Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (*Caretta caretta*), pp. 238-240. In: In: K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar (Comps.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351. 323 p.

Ljungblad, D. K., P. D. Scogginas, and W. G. Gilmartin. 1982. Auditory thresholds of a captive eastern Pacific bottle-nosed dolphin, *Tursiops* sp. J. Acous. Soc. Am. 72: 1726-1729.

Lockyer, C. 1984. Review of baleen whale (Mysticeti) reproduction and implications for management. Rep. Int. Whal. Comm. Spec. Issue 6: 27-50.

Mackintosh, N. A. 1965. The Stocks of Whales. Fishing News (Books). London. 232 p.

Mackintosh, N. A. and J. F. G. Wheeler. 1929. Southern blue and fin whales. Disc. Rep. 1: 257-540.

Martin, A. R., ed. 1990. Whales and Dolphins. Salamander Books, London. 192 p.

McBreanty, D. A., M. A. Message, and G. A King. 1986. Observations of small cetaceans in the northeast Atlantic Ocean and the Mediterranean Sea: 1978-1982. In: Bryden, M. M. and R. J. Harrison (eds.). Research on Dolphins. Clarendon Press. New York. 478 p.

McCowan, B. and D. Reiss. 1995. Quantitative comparison of whistle repertoires from captive adult bottlenose dolphins (Delphinidae, *Tursiops truncatus*): A re-evaluation of the signature whistle hypothesis.. Ethology. 100: 194-209.

McDonald, M. A., J. A. Hildebrand, and S. C. Webb. 1995. Blue and fin whales observed on a seafloor array in the northeast Pacific. J. Acous. Soc. Am. 98: 712-721.

McLeod, P. J. 1986. Observations during the stranding of one individual from a pod of pilot whales, *Globicephala melaena*, in Newfoundland. Can. Field-Nat. 100(1): 137-139.

Mellinger, D. K. and C. W. Clark. 1997. Methods for automatic detection of mysticete sounds. Mar. Freshwater Behav. Physiol. 29: 163-181.

Millais, J. G. 1906. *The Mammals of Great Britain and Ireland*. Vol. III. Longmans, Green, and Co. London. 384 p.

Miyashita, T. 1993. Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery. Rep. Int. Whal. Comm. 43: 417-437.

Moore, S. E. and S. H. Ridgway. 1995. Whistles produced by common dolphins from the southern California Bight. Aquat. Mamm. 21: 55-63.

Moein, S. E., J. A. Musick, and M. L. Lenhardt. 1994. Auditory behavior of the loggerhead sea turtle (*Caretta caretta*). In: K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar (Comps.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351. 323 p.

Mullin, K. D. 1998. Abundance and Distribution of Cetaceans in the Southern U.S. Atlantic Ocean during Summer 1998. Southeast Fisheries Science Center, National Marine Fisheries Service. 27 pp.

Mullin, K. D., L. V. Higgins, T. A. Jefferson, and L. J. Hansen. 1994. Sightings of the Clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. Mar. Mammal Sci. 10: 464-470.

Mullin, K. D., W. Hoggard, C. L. Roden, R. R. Lohoefener, C. M. Rogers, and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study MMS 91-0027. Report from U. S. National Marine Fisheries Service, Pascagoula, USA, for U. S. Minerals Management Service, New Orleans, USA. 108 p.

National Aquarium. 1997. Marine Animal Rescue Program Stranding Reports 1991-1996.

National Marine Fisheries Service (NMFS). 1991. *Recovery Plan for the Humpback Whale (Megaptera novaeangliae)*. Report prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland, 105 p.

National Marine Fisheries Service (NMFS). 1999. Information from internet web site. http://www.st.nmfs.gov/commercial/landings/caveat.html. March 1999.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (U.S. FWS). 1992. *Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico*. Department of Commerce, National Marine Fisheries Service, Washington, D.C.

Nelson, D. and J. Lien. 1996. The status of the long-finned pilot whale, *Globicephala melas*, in Canada. Can. Field-Nat. 110: 511-524.

Nishiwaki, M. 1952. On the age determination of Mystacoceti, chiefly blue and fin whales. Sci. Rep. Whales Res. Inst. 7: 87-119.

Norris, K. S. and T. P. Dohl. 1980. Behavior of the Hawaiian spinner dolphin, *Stenella longirostris.* Fish. Bull. 77: 821-849.

Norris, K. S., B. Würsig, R. S. Wells, and M. Würsig. 1994. *The Hawaiian Spinner Dolphin*. University of California Press. Berkeley. 408 p.

Norris, T. F. 1994. Effects of boat noise on the acoustic behavior of humpback whales. J. Acous. Soc. Am. 96 (5 Pt. 2): 3251.

Office of Naval Research. 1997a. Software Design Document for the Parabolic Equation Model, Version 4.0. October, 1997.

Office of Naval Research. 1997b. Software Requirements Specifications for the Parabolic Equation Model, Version 4.0. October, 1997.

Office of Naval Research. 1997c. Software Test Description for the parabolic Equation Model, Version 4.0. October , 1997.

Papastavrou, V., S. C. Smith, and H. Whitehead. 1989. Diving behavior of the sperm whale, *Physeter macrocephalus,* off the Galapagos Islands. Can. J. Zool. 67: 839-846.

Patterson, B. and G. R. Hamilton. 1964. Repetitive 20 cycle per second biologically hydroacoustic signals at Bermuda. In: Tavolga, W. N. (ed.). Marine Bio-acoustics. Pergamon Press, New York. 413 p.

Payne, P.M. and D.W. Heinemann. 1993. The distribution of pilot whales in the shelf/shelf-edge and slope waters of the northeastern United States, 1978-1988. Rep. Int. Whal. Comm. Spec. Issue 14: 51-68.

Payne, R. S. and S. McVay. 1971. Songs of humpback whales. Science. 173: 585-597.

Perrin, W. F. and J. W. Gilpatrick, Jr. 1994. Spinner dolphin *Stenella longirostris* (Gray, 1828). In: Ridgway, S. H. and R. Harrison (eds.). Handbook of Marine Mammals, Vol. 5: The first book of dolphins. Academic Press, New York. 416 p.

Perrin, W. F. and A. A. Hohn. 1994. Pantropical spotted dolphin *Stenella attenuata*. In: Ridgway, S. H. and R. Harrison (eds.). Handbook of Marine Mammals, Vol. 5: The first book of dolphins. Academic Press, New York. 416 p.

Popov, V. V. and V. O. Kishin. 1998. EEG study of hearing in the common dolphin, *Delphinus delphis.* Aquat. Mamm. 24: 13-20.

Popper, A. N. 1980. Sound emission and detection by delphinids. In: Herman, L. M. (ed.). Cetacean Behavior: Mechanisms and functions. Wiley. New York. 463 p.

Pritchard, P. C. H. 1997. Evolution, phylogeny, and current status. In: Lutz, P. and J. Musick (eds.). The Biology of Sea Turtles. CRC Press, Inc. New York. 415 p.

Ray, G. C., E. Mitchell, D. Wartzok, V. Koxicki, and R. Maiefski. 1978. Radio tracking of a fin whale (*Balaenoptera physalus*). Science. 202: 521-524.

Richardson, W. J., C. R. Greene, Jr., C. I. Malme, and D. H. Thompson. 1995. Marine Mammals and Noise. Academic Press, Inc. New York. 576 p.

Ridgway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson, 1969. Hearing in the giant sea turtles. J. Acoust. Soc. Am. 59(Suppl. 1):S46.

Ridgway, S. H., D. A. Carder, R. R. Smith, T. Kamolnick, C. E. Schlundt, and W. R. Elsberry. 1997. Behavioral responses and temporary shift in masked hearing threshold of bottlenose dolphins, *Tursiops truncatus*, to 1-second tones of 141 to 203 dB re 1 μPa. Naval Command, Control, and Ocean Surveillance Center, RDT&E Division, San Diego, California. Tech. Report 1751.

Ridgway, S. H. 1999. Personal communications with Mr. Stanley Labak, Marine Acoustics, Inc., on April 7, 1999.

Ross, D. 1976. Mechanics of Underwater Noise. Pergamon Press. New York. 375 p.

Santoro, A. K., K. L. Marten, and T. W Cranford. 1989. Pygmy sperm whale sounds (*Kogia breviceps*). Abstracts of the 8th Biennial Conference on the Biology of Marine Mammals, Pacific Grove, CA. December, 1989.

Sauerland, M. and G. Dehnhardt. 1998. Underwater audiogram of a tucuxi (*Sotalia fluviatilis guianensis*). J. Acous. Soc. Am. 84: 2273-2275.

Schreer, M., B. Hofmann, and P. I. Behr. 1998. Discrete pod-specific call repertoires among short-finned pilot whales (*Globicephala macrorhynchus*) off the southwest coast of Tenerife, Canary Islands. Abstracts of the World Marine Mammal Science Conference, Monaco. January, 1998.

Schevill, W. E. 1964. Underwater sounds of cetaceans. In: Tavolga, W. N. (ed.). Marine Bio-acoustics. Pergamon Press, Inc. New York. 413 p.

Schevill, W. E. and W. A. Watkins. 1972. Intense low-frequency sounds from an Antarctic minke whale, *Balaenoptera acutorostrata*. Breviora. 388:1-8.

Schultz, K. W., D. H. Cato, P. J. Corkeron, and M. M. Bryden. 1995. Low frequency narrow-band sounds produced by bottlenose dolphins. Mar. Mamm. Sci. 11: 503-509.

Shallenberger, E. E. 1978. Activities possibly affecting the welfare of humpback whales. In: Norris, K. S., R. R. Reeves (eds.). Report on a workshop on problems related to humpback whales (*Megaptera novaeangliae*) in Hawaii. Report No. MMC-77/03 from Sea Life Inc. for U. S. Marine Mammal Commission, Washington. 90 p.

Sharpe, F. A. and L. M. Dill. 1997. The behavior of Pacific herring schools in response to artificial humpback whale bubbles. Can. J. Zool. 75: 725-730.

Simmonds, M. P. and J. D. Hutchinson, eds. 1996. The Conservation of Whales and Dolphins. John Wiley and Sons. New York. 476 p.

Smith, T. D., J. Allen, P. J. Clapham, P. S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, P. J. Palsbøll, J. Sigurjónsson, P. T. Sevick, and N. Øien. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). Marine Mammal Science. 15(1): 1-32.

Steiner, W. W. 1981. Species-specific differences in pure tonal whistle vocalizations of five western North Atlantic dolphin species. Behav. Ecol. Sociobiol. 9(4): 241-246.

Stewart, B. S. and S. Leatherwood. 1985. Minke whale *Balaenoptera acutorostrata* (Lacépède, 1804). In: Ridgway, S. H. and R. Harrison (eds.). Handbook of Marine Mammals, Vol. 3: The sirenians and baleen whales. Academic Press. New York. 362 p.

Suárez-C M. L., F. Trujillo, and D. Cadena. 1994. Distribución espacio-temporal y aspectos del comportamiento y de la interacción con la pesquería artesanal de *Tursiops truncatus* y *Stenella attenuata* en el Parque Nacional Utria, Choco, Colombia. IX Seminario Nacional de Ciencias y Tecnologías del Mar y Congreso Latinoamericano en Ciencias del Mar, Medellín, Colombia.

Taruski, A. G. 1979. The whistle repertoire of the North Atlantic pilot whale (*Globicephala melaena*) and its relationship to behavior and environment. In: Winn, H. E. and B. L. Olla (eds.). Behavior of Marine Animals, Vol. 3: Cetaceans.

Thompson, P. O., W. C. Cummings, and S. J. Ha. 1986. Sounds, source levels, and associated behavior of humpback whales, southeast Alaska. J. Acoust. Soc. Am. 80(3): 735-740.

Thompson, P. O., L. T. Findley, and O. Vidal. 1992. 20-Hz pulses and other vocalizations of fin whales, *Balaenoptera physalus*, in the Gulf of California, Mexico. J. Acoust. Soc. Am. 92: 3051-3057.

Thompson, T. J., H. E. Winn, and P. J. Perkins. 1979. Mysticete sounds. In: Winn, H. E. and B. L. Olla (eds.). *Behavior of Marine Animals*, Vol. 3: Cetaceans. Plenum Press, Inc. New York.

Tomilin, A. G. 1957. Cetacea. In: Heptner, V. G. (ed.). Mammals of the USSR and adjacent countries. Vol. 9. Israel Program for Scientific Translations, Jerusalem. 1967.

Tremel, D. P., J. A. Thomas, and K. T. Ramírez. 1998. Underwater hearing sensitivity of a Pacific white-sided dolphin, *Lagenorhynchus obliquidens*. Aquat. Mamm. 24: 63-69.

Tyack, P. and H. Whitehead. 1983. Male competition in large groups of wintering humpback whales. Behaviour. 83: 132-154.

Urick, R. J. 1983. *Principles of Underwater Sound*, 3rd edition. McGraw-Hill, Inc. New York. 423 p.

U.S. Army Missile Command (USAMC). 1994. *Life Cycle Environmental Assessment For Hellfire Modular Missile Systems*. U.S. Army Missile Command, Department of the Army. August 1994.

U.S. Department of the Navy (U.S. DoN). 1977. Naval Research Laboratory Report: Effects of Aluminized Fiberglass on Representative Chesapeake Bay Marine Organisms report. Prepared by Block and Schiff of Systems Consultants, Inc. Report number 6132008. November 23, 1977.

U.S. Department of the Navy (U.S. DoN). 1991. Project Beartrap: LAMPS MK-III Self Noise Test, Briefing by Jack Savage, Department of the Navy, Air ASW Systems Program Office, Naval Air Station, Beartrap.

U.S. Department of the Navy (U.S. DoN). 1994. Draft Interim Guidance on Compliance with the Clean Air Act General Conformity Rule, Chief of Naval Operations (Ser N457/4U596107 dtd 26 Apr. 94), April 26, 1994.

U.S. Department of the Navy (U.S. DoN). 1997a. *Environmental Assessment: F/A-18E/F Stores Separation Testing*, Department of the Navy, Naval Air Warfare Center, Aircraft Division, Patuxent River Naval Air Station. January 1997.

U.S. Department of the Navy (U.S. DoN). 1997b. *Environmental Assessment of the Standoff Land Attack Missile (SLAM) and SLAM Expanded response Developmental Test and Evaluation Firings*. Department of the Navy, San Nicolas Island, Ventura County, California.

U.S. Department of the Navy (U.S. DoN). 1997c. *Environmental Assessment of the Forward Looking Infrared Receiver and Laser Rangefinder/Designator Testing of the SH-60B Helicopter at the Naval Air Station Patuxent River, Chesapeake and Atlantic Test Ranges.* Department of the Navy. May 1997.

U.S. Department of the Navy (U.S. DoN). 1997d. *Environmental Assessment of the Use of Selected Navy Test Sites for Development Tests and Fleet Training Exercises of the MK48 Torpedoes*, CONFIDENTIAL DOCUMENT, Department of the Navy, Office of Undersea Warfare. July 1997.

U.S. Department of the Navy (U.S. DoN). 1998a. *Environmental Assessment of the Armed Helo the System for the H-60 Helicopters at the Naval Air Station Patuxent River Complex and the Atlantic Test Range*. Department of the Navy. February 1998.

U.S. Department of the Navy (U.S. DoN). 1998b. *Final Environmental Assessment of the Tomahawk Flight Test Operations on the West Coast of the United States*. Department of the Navy, Naval Facilities Engineering Command, Southwest Division.

U.S. Department of the Navy (U.S. DoN). 1998c. *Navy Environmental and Natural Resources Program Manual.* OPNAVINST 5090.1B. Department of the Navy. February 2, 1998.

U.S. Department of the Navy (U.S. DoN). 1998d. *Final Environmental Impact Statement for the Realignment of F/A-18 Aircraft and Operational Functions form the Naval Air Station Cecil Field, Florida to other East Coast Installations*. Department of the Navy. March 1998.

U.S. Department of the Navy (U.S. DoN). 1998e. *Environmental Assessment of the Nonwarhead Standoff Land Attack Missile (SLAM) and Future Model SLAM Firings*. Department of the Navy, Naval Air Warfare Center, Weapons Division. November 1998.

U.S. Department of the Navy (U.S. DoN). 1998f. *Final Environmental Impact Statement for Increased Flight and Related Operations in the Patuxent River Complex, Patuxent River, Maryland*. Department of the Navy. December 1998.

U.S. Department of the Navy (U.S. DoN). 1999. *Operating Control Directive for Range Operations Environmental Mitigation Procedures*. Department of the Navy. March 1999.

U.S. Environmental Protection Agency (U.S. EPA). 1991. *Emissions Inventory Requirements for Ozone State Implementation Plans.* EPA 450/491-010. Environmental Protection Agency. March 1991.

Wade, P. R. and T. Gerrodette. 1993. Estimates of cetacean abundance and distribution in the eastern tropical Pacific. Rep. Int. Whal. Comm. 43: 477-493.

Wang Ding, B. Würsig, and W. Evans. 1995. Comparisons of whistles among seven odontocete species. In: Kastelein, R. A., J. A. Thomas, and P. E. Nachtigall (eds.). Sensory Systems of Aquatic Mammals.

Waring, G. T., D. L. Palka, P. J. Clapham, S. Swartz, M. C. Rossman, T. V.N. Cole, K. D. Bisack, and L. J. Hansen. 1998. U. S. Atlantic Marine Mammal Stock Assessments. NOAA Tech. Memo. NMFS-NE-116.

Watkins, W. A. 1967. The harmonic interval: fact or artifact in spectral analysis of pulse trains. In: Tavolga, W. N. (ed.). Marine Bio-acoustics, Vol. 2. Pergamon Press, New York. 353 p.

Watkins, W. A. 1980. Click sounds from animals at sea. In: Busnel, R-G and J. F. Fish (eds.). Animal Sonar Systems. Plenum Press. New York. 1135 p.

Watkins, W. A. 1981. Activities and underwater sounds of fin whales. Sci. Rep. Whales Res. Inst. 33:83-117.

Watkins, W. A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science. 2: 251-262.

Watkins, W. A. and W. E. Schevill. 1977. Sperm whale codas. J. Acoust. Soc. Am. 62(6): 1485-1490 + phono record.

Watkins, W. A., K. E. Moore, and P. Tyack. 1985. Sperm whale acoustic behaviors in the southeast Caribbean. Cetology. 49: 1-15.

Watkins, W. A., P. Tyack, K. E. Moore, and J. E. Bird. 1987. The 20-Hz signals of finback whales (*Balaenoptera physalus*). J. Acous. Soc. Am. 82(6): 1901-1912.

Watts, A. J. (ed). 1995. Jane's Underwater Warfare Systems, 7th Ed. 1995-1996. Jane's Information Group, Inc. Alexandria, VA. 432 pp.

Weilgart, L. S. and H. Whitehead. 1990. Vocalization of the North Atlantic pilot whale (*Globicephala melaena*) as related to behavioural contexts. Behavioural Ecology and Sociobiology. 26(6): 399-402.

Winn, H. E. and P. J. Perkins. 1976. Distribution and sounds of the minke whale, with a review of mysticete sounds. Cetology. 19: 1-12.

Winn, H. E., P. Perkins, and T. Poulter. 1970a. Sounds of the humpback whale. Proceedings of the 7th Annual Conference on Biological Sonar and Diving Mammals, Stanford Research Institute, Menlo Park, California.

Winn, H. E., P. Perkins, and T. Poulter. 1970b. Sounds and behavior of the northern bottlenosed whale. Proceedings of the 7th Annual Conference on Biological Sonar and Diving Mammals, Stanford Research Institute, Menlo Park, California.

Wyneken, J. 1997. Sea turtle locomotion: Mechanisms, behavior, and energetics. In: Lutz, P. and J. Musick (eds.). The Biology of Sea Turtles. CRC Press, Inc. New York. 415 p.

Zanardelli, M. G. Notarbartolo di Sciara, and G. Pavaa. 1990. Characteristics of underwater acoustic signals produced by the striped dolphin, *Stenella coeruleoalba*, in the central Mediterranean Sea. Proceedings of the 4th Annual Conference of the European Cetacean Society, Palma de Mallorca. March 1990.

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APPENDIX A

DESCRIPTION OF STORES

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DESCRIPTION OF STORES

The SH-60R is an aircraft capable of antisubmarine warfare (ASW), search and rescue operations, drug interdiction, antisurface warfare (ASuW), cargo lift, and special operations. Antisurface weapons include the PENGUIN anti-ship missile and the laser guided HELLFIRE missile. ASW weapons include a variety of sonobuoys and torpedoes used to track and sink submarines. The SH-60R will also have the ability to deploy chaff and flares to defend itself against missile attacks from hostile targets. For the purposes of this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA), stores may be defined as any group of weapons systems, inert components, and other related aircraft hardware that may be completely detached from an aircraft during systems testing or operations.

The stores proposed for SH-60R testing can be classified in the following categories: missiles, sonobuoys, decoys (chaff and flares), marine markers, and torpedoes. The purpose of this section is to describe the physical specifications and characteristics of each of these stores.

Missiles

The SH-60R is capable of carrying two different missile systems: the AGM-119 PENGUIN Missile and the AGM-114 HELLFIRE Missile. Both are used to attack hardened targets, but the PENGUIN is designed specifically to attack ships at sea while the HELLFIRE is more of an "all-purpose" air-to-surface weapon. For the purposes of testing, both missiles will be comprised of an inert warhead with a "live" solid rocket motor.

The AGM-119 PENGUIN

Launch Weight:	385 kg (847 lbs)
Length:	3.06 m (120.48 in)
Diameter:	28.45 cm (11.2 in)
Wing Span:	71.12 cm (39 in)
Warhead:	inert, mass equivalent
Guidance:	inertial and infrared terminal
Propellant:	solid propellant rocket motor and solid propellant booster
Range:	25 nm/35 km (21.7 mi)

Figure A-1: AGM-119 Penguin Missile

The AGM-114 HELLFIRE

Launch Weight:	50 kg (110 lbs)
Length:	1.62 m (63.6 in)
Diameter:	17.78 cm (7 in)
Wing Span:	33.53 cm (1.1 ft)
Warhead:	inert, mass equivalent
Guidance:	semi-active laser homing
Propellant:	solid fuel rocket
Range:	8 km (4 mi)

Figure A-2: The AGM-114 HELLFIRE Missile

Sonobuoys

Several different types of sonobuoys are scheduled to be used in Developmental Testing (DT) and Operational Testing (OT) of the SH-60R. These include the SSQ-36, SSQ-57, SSQ-53, SSQ-62, and SSQ-77. The SSQ-36, SSQ-57, SSQ-53, SSQ-62, and SSQ-77 sonobuoys used in the DT and OT of the SH-60R typically have the following characteristics (exact characteristics are dependent upon the system being used).

Weight:	11.38 – 20.02 kg (25 – 44 lbs)
Functions:	passive measurement of thermal; gradient measurement or acoustical energy; or active detection (pinging)
Operating Life:	12 minutes to 8 hours
Power Source:	seawater-activated battery
Activation Time:	15 seconds to 3 minutes

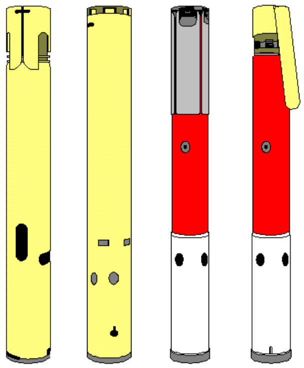

Figure A-3: Various Sonobuoys To Be Used By the SH-60R.

The SSQ-36 series sonobuoy is designated as a Bathythermograph (BT) sonobuoy. A BT sonobuoy measures water temperature as a function of depth (i.e., temperature profile). Temperature differences cause sound waves to travel at different speeds at different depths which directly impacts the way the sound signature from a submarine is distributed in the ocean. Sound rays which can be traced as normal to the acoustic wavefronts are often used to describe the esonification patterns in waters with spatial temperature variations. Measurements of the variation of water temperature with depth can be used by aircraft to calculate sonobuoy depth settings which will optimize submarine detection ranges. As a result, sound waves form into different sound radiation patterns. By knowing the temperature profile of the ocean, aircrews can select the correct sonobuoy depth settings to optimize submarine detection.

The SSQ-53 series sonobuoy is designated as a Directional Frequency and Ranging (DIFAR) sonobuoy. A DIFAR sonobuoy is a passive listening receiver that determines bearings associated to underwater sounds and transmits that acoustic information for processing aboard an ASW aircraft via a radio-frequency (RF) link. The sensor operator aboard the aircraft sorts and classifies the various sounds in the water. If the sounds associated with a submarine are detected and classified, then the aircrew uses the submarine-related DIFAR bearings to localize, track and fix the submarine position.

The SSQ-57 series sonobuoy is designated as a Low Frequency and Ranging (LOFAR) sonobuoy. A LOFAR sonobuoy is a passive sonobuoy, that unlike the AN/SSQ-53 DIFAR sonobuoy, provides no bearing information from the sonobuoy to the submarine. However, the LOFAR sonobuoy does provide an extended acoustic frequency coverage that the AN/SSQ-53 DIFAR sonobuoy can not match. This extended frequency coverage, coupled with superior calibration, makes the AN/SSQ-57 LOFAR sonobuoy as the sensor of choice in collecting acoustic intelligence from submarines. Additionally, this sonobuoy is quite suitable for measuring the loudness of various submarine sounds as well as the background noises in the ocean.

The SSQ-62 series sonobuoy is designated as a Directional Command Activated Sonobuoy System (DICASS) sonobuoy. A DICASS sonobuoy is commanded by an ultra-high frequency (UHF) downlink radio command from the monitoring ASW aircraft. Upon receipt of a valid radio signal, the DICASS sonobuoy transmits an active sonar pulse in all directions (omnidirectional). This acoustic pulse, or ping, reflects off any obstructions in its path. Most reflections, depending upon signal amplitude and background noise (reverberation), are detected by the DICASS sonobuoy. All reflections are transmitted on the very-high frequency (VHF) uplink signal back to the monitoring ASW aircraft. Range and bearing information to any submarine echo is processed and used to precisely fix the submarine’s position. Additionally, the speed of the submarine echo relative to the slowly drifting DICASS sonobuoy is also obtained.

The SSQ-77 series sonobuoy is designated as a Vertical Line Array DIFAR (VLAD) sonobuoy. A VLAD sonobuoy uses passive sonar beam-forming techniques to process desired acoustic signals arriving at the hydrophone array from one acoustic transmission path and rejecting undesired signals like rain and distant shipping arriving from other sound paths. The array consists of several hydrophones placed at fixed points along a vertical line. Each "tuned" hydrophone is designed to only process acoustic signals of pre-determined frequency bands. The array also includes a DIFAR hydrophone similar to the SSQ-53 DIFAR series sonobuoys which is used to obtain bearing information to the submarine.

Sonobuoys are not designed to be retrieved after deployment and are designed to scuttle themselves upon completion of their operation. This process is usually effectuated by deflation of their flotation device or allowing seawater into the body of the unit, and it results in the sonobuoy quickly sinking to the ocean floor.

Decoys

Chaff is the collective term for aggregates of metallic or metal-coated strips or cylinders that are employed as highly efficient reflectors of radio-frequency electromagnetic radiation. Chaff is launched from aircraft or ships in military applications as a means to degrade the performance of radar and radar controlled weapons. Chaff flutters through the air when released from the aircraft. Its rate of fall has been conservatively estimated to be 15 meters per minute (50 feet per minute) or less and it is easily carried by wind and air currents. As a result, extremely wide dispersion patterns are produced.

Chaff technology includes both aluminum foil and aluminum coated fiberglass products that remain in the environment for prolonged periods. The aluminum foil chaff consists of aluminum foil and nitrocellulose type lacquer coating. Chaff in various forms has been in use by the military for many years.

Flares are burning pyrotechnics that are formulated to maximize infrared at wave lengths used by the seekers of infrared homing missiles. The flare is ejected from the aircraft as a decoy for the infrared homing missiles. Infrared countermeasure flares are generally composed of powdered combustible material, typically powdered magnesium, a binder, and a trace of other compounds required for ignition and control of flare burning dynamics. Flares are designed to provide a brief, high intensity heat source for up to 10 seconds.

Decoys to be used with the SH-60R have the following characteristics:

Weight:	0.2 - 1.4 kg (0.4 - 3 lbs)
Length:	148 - 400 mm (6 - 16 in)
Diameter:	36 - 63 mm (1.4 - 2.5 in)

APPENDIX B

DESCRIPTION AND MAPS
OF PREFERRED ALTERNATIVE TEST LOCATIONS

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Naval Air Station Patuxent River Complex (NAS PRC)

NAS PRC is defined as the shore station, Webster Field Annex, the Chesapeake Test Range (CTR) over the Chesapeake Bay, and supersonic test corridors. The Chesapeake Bay is the largest and most productive estuary in the United States (U.S.) at 314 kilometers (km) or 195 miles (mi) long and 6,500 km^2 (2,500 mi^2) in area. Water depths in the NAS PRC range from 0 meters (m) to 50 m (0 feet (ft) to 164 ft).

This Navy installation and military range has been designated by the Department of Defense (DoD) as the premier naval aviation research, development, test, and evaluation (RDT&E) center. All the necessary facilities (e.g., multipurpose instrumented ranges, a shielded hanger, fully integrated weapons system laboratories, ship to ground station, etc.) are available to support SH-60R tests. NAS PRC will be the primary testing location for the SH-60R. In addition, NAS PRC has recently completed *the Final Environmental Impact Statement (EIS) for Increased Flight and Related Operations in the Patuxent River Complex, Patuxent River, Maryland* (U.S. DON, 1998f). The scope of proposed SH-60R tests, other than Airborne Low Frequency Sonar (ALFS) active pinging tests, are similar to those addressed in the Final Environmental Impact Statement (EIS). ALFS shallow water dips, and a short duration active pinging scenario, in the CTR are conducted to determine proper system functionality prior to transit to the other ALFS testing locations (Atlantic Warning Area (AWA), Atlantic Undersea Test and Evaluation Center (AUTEC), and Ex-USS *Salmon* site).

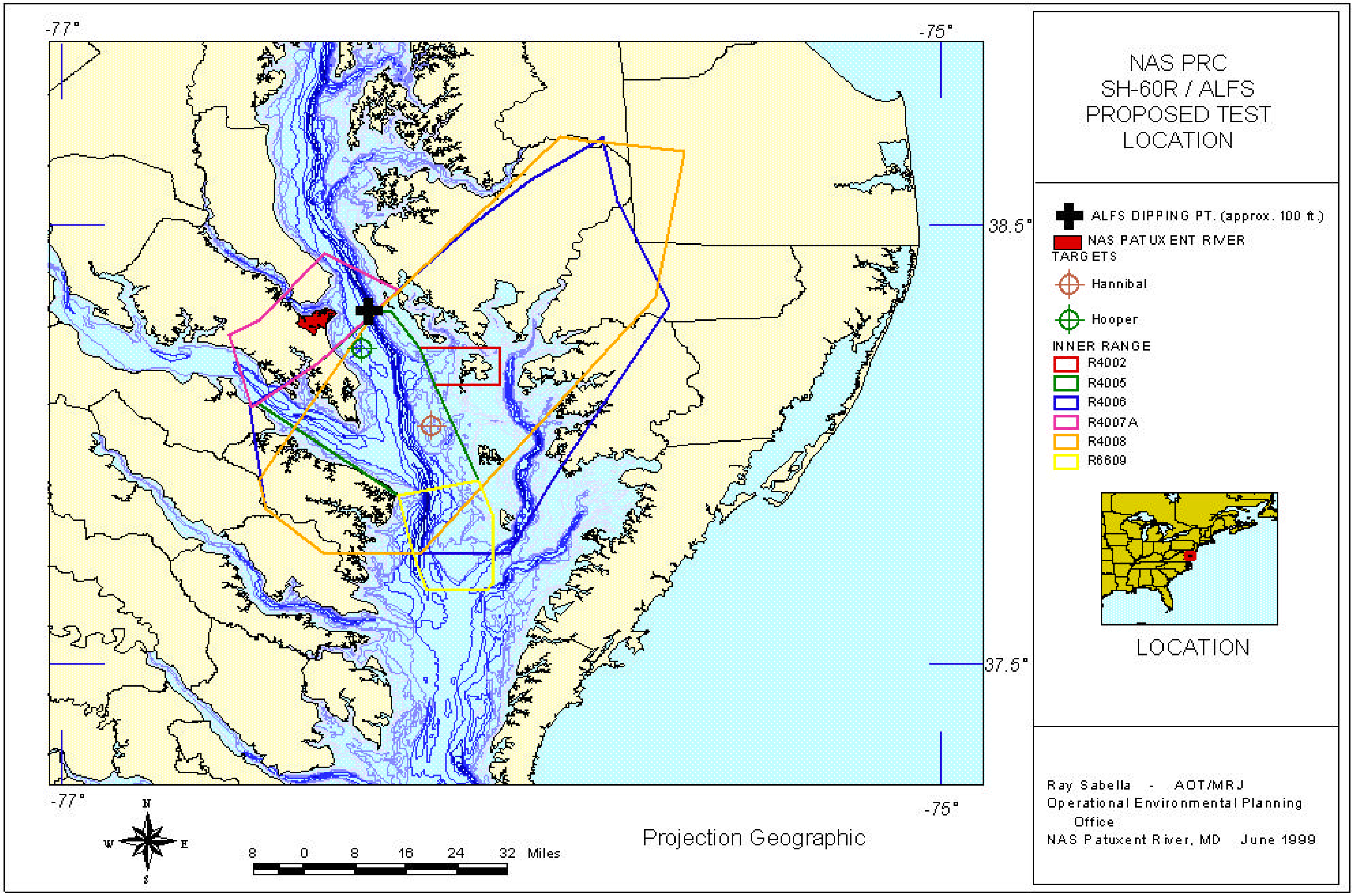

Figure B-1:
Naval Air Station Patuxent River Complex (NAS PRC) Proposed Test Location

Atlantic Warning Area (AWA)

The AWA is under the control of the Fleet Area Control and Surveillance Facility (FACSFAC), Virginia Capes (VACAPES), and includes areas in the offshore mid-Atlantic Ocean. They range from 72º 45'W to 75º 30' W, extending from the DE coast to the southern VA coast. Water depths range from 0 m to roughly 4,000 m (2.5 mi).

The warning areas off the coast of VA and MD provide shallow and deep-water testing opportunities for the SH-60R and ALFS in proximity to NAS PRC. Bathymetry, ocean floor, and ocean layer characteristics are conducive for testing the ALFS at various depths and operational scenarios. In addition, the AWA offers the ability of the program to ensure the proper function and operation of the ALFS system prior to transiting to AUTEC and the Ex-USS *Salmon* site for more extensive tests. AWA also has the needed range and airspace to perform the various SH-60R mission scenarios and it is used on a regular basis by NAS PRC since it is considered a normal weapons target area. In addition, the required distances for established safety hazard patterns of the missiles can be achieved and maintained during proposed tests.

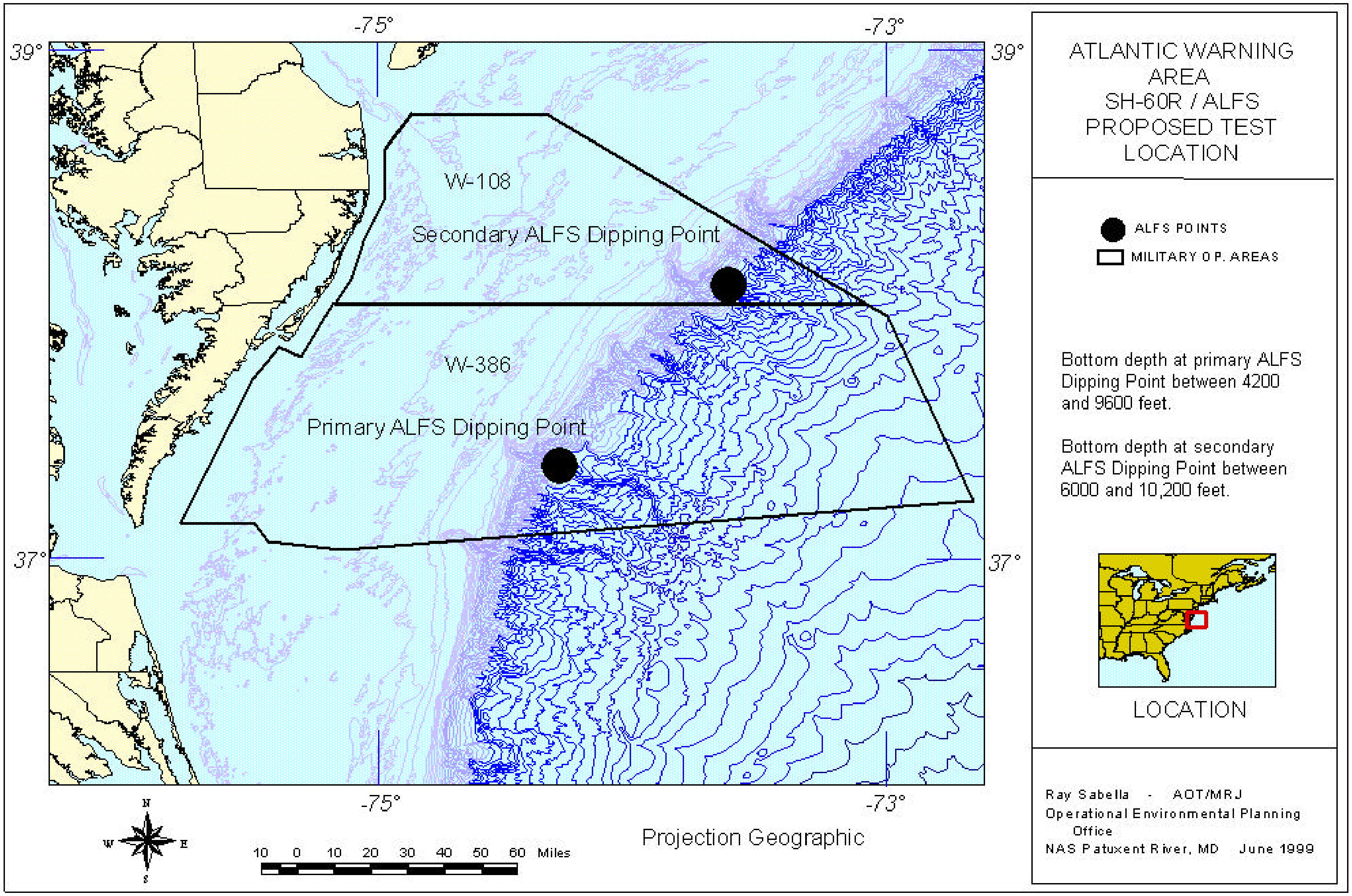

Figure B-2:
Atlantic Warning Area (AWA) Proposed Test Location

Ex-USS *Salmon* Site

The Ex-USS *Salmon* site is a sunken diesel submarine, which consists of a square approximately 20 nautical miles (nm) (north-south) by 20 nm (east-west), centered at approximately 60 nm east-southeast of New York City off the coast of NJ. The bottomed Ex-USS *Salmon* is positioned on the western portion of this box at 39º42.2'N/72º18.2'W near the edge of the Continental Shelf. It is bounded by the following geographic coordinates: 39º47'N/72º22'W; 39º47'N/71º52'W; 39º27'N/72º22'W; and 39º27'N/71º52'W.

This sunken diesel submarine site is an established Naval Undersea Warfare Center (NUWC) range used for ASW and undersea test activities. The Ex-USS *Salmon* site provides an excellent opportunity for test personnel to realistically verify the mission capability of the SH-60R and ALFS.

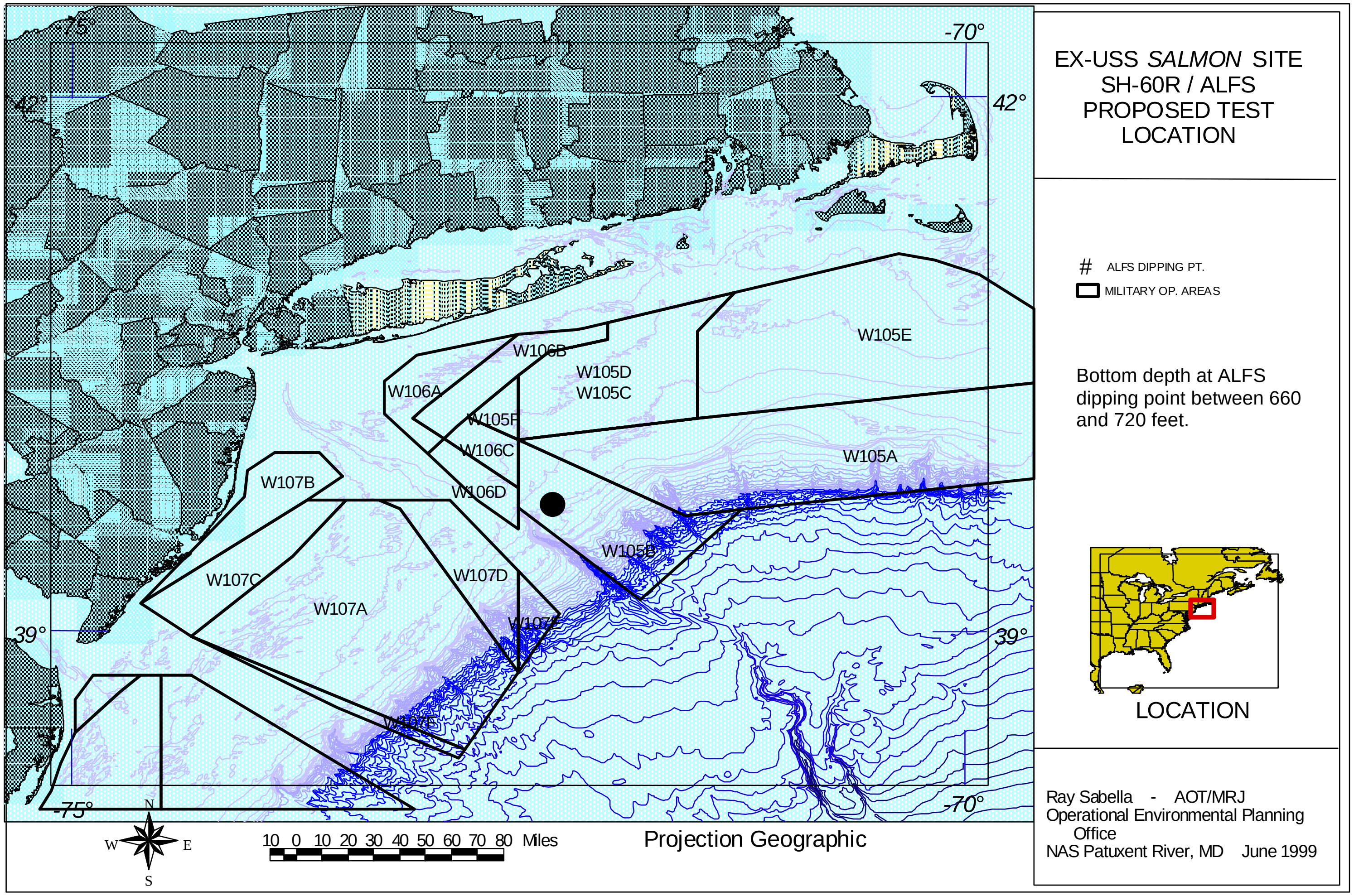

Figure B-3:
Ex-USS *Salmon* Site Proposed Test Location

Marine Corps Air Station (MCAS) Cherry Point

MCAS Cherry Point is located in eastern NC, occupying approximately 4,640 hectares (11,600 acres) in the City of Havelock near the Neuse River. The station is a Marine Corps master jet base and is designated an aerial point of embarkation. Approximately 190,000 military operations are conducted per year using MCAS Cherry Point facilities and air fields, as well as nearby military training areas and target ranges (U.S. DON, 1998d). These military training areas (designated in authorized air and surface water areas) extend along the Atlantic coast from the Chesapeake Bay to Pamlico Sound in NC. Target areas (air-to-surface target ranges) used by MCAS Cherry Point include:

- BT-9 located on Brandt Island Shoal within R-5306A, approximately 150 km (95 mi) south of NAS Oceana, in Pamlico Sound, Pamlico County, NC.
- BT-11 (approximately 12,500 acres) located within R-5306A in Carteret County, NC on Piney Island near the mouth of the Neuse River.

This is an established Marine Corps station to support the deployment of attack aircraft and helicopters and other operations, using nearby military training and target areas. MCAS Cherry Point Range Control administers these target ranges. BT-9 is an unmanned submerged ship haul target for conventional weapons delivery (e.g., practiced on inert rockets, flares, and chaffs). BT-11 is a multipurpose target complex used for air-to-ground weapons training. It is comprised of water- and land-based targets (e.g., large bullseyes, submerged barges and patrol boats, a simulated runway target, a fuel farm target, and a surface-to-air missiles target). Stores used include practice bombs, inert rockets, inert strafing, flares, and chaffs. MCAS Cherry Point target areas and electronic warfare and threat simulation testing capabilities are ideally suited for proposed SH-60R tests. In addition, MCAS Cherry Point is in close proximity to NAS PRC.

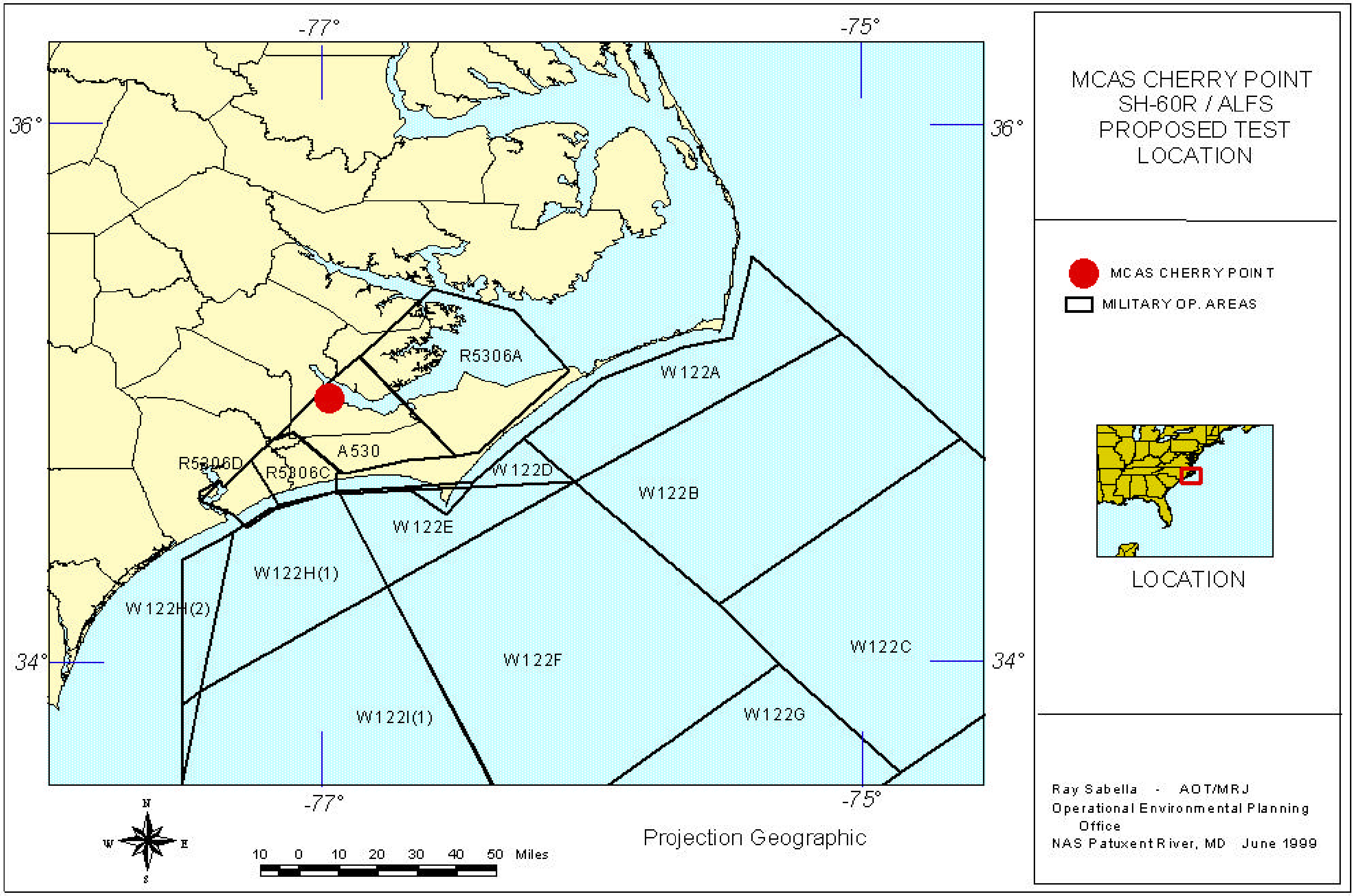

Figure B-4:
Marine Corps Air Station (MCAS) Cherry Point Proposed Test Location

Atlantic Undersea Test and Evaluation Center (AUTEC)

AUTEC is located at Andros Island in the Bahamas, approximately 177 nm from West Palm Beach, FL. Andros Island parallels the western side of the Tongue of the Ocean (TOTO). The TOTO is a unique geological feature, a steep-sided, deep-water box canyon in the northwestern part of the Bahama Platform (approximately 204 km (110 nm) long and 37 km (20 nm) wide, and generally more than 1,219 m (4,000 ft) deep. The TOTO ends in a circular cul-de-sac bound on the west by the shallow water of the Great Bahama Bank and on the south and east by the shallow water of the Exuma Platform.

The mission of AUTEC is to provide shallow and deep water test and evaluation facilities for making underwater acoustic measurements, testing and calibrating sonars, and providing accurate underwater, surface, and in-air tracking data on ships, submarines, aircraft, and weapon systems in support of Navy's antisubmarine warfare (ASW) and undersea warfare (USW) programs. AUTEC also provides training and ASW fleet assessment and operational readiness testing for the United States and allied Navies. In addition, AUTEC has completed a *Final Environmental Review for the Adoption of a Range Management Plan* for their facilities and ranges (Continental, 1997). The scope of the proposed SH-60R/ALFS tests is similar to those addressed in the Final Environmental Review document. In addition, AUTEC's *Operating Control Directive for Range Operations Environmental Mitigation Procedures*, 1999, further defines requirements while using AUTEC facilities and ranges.

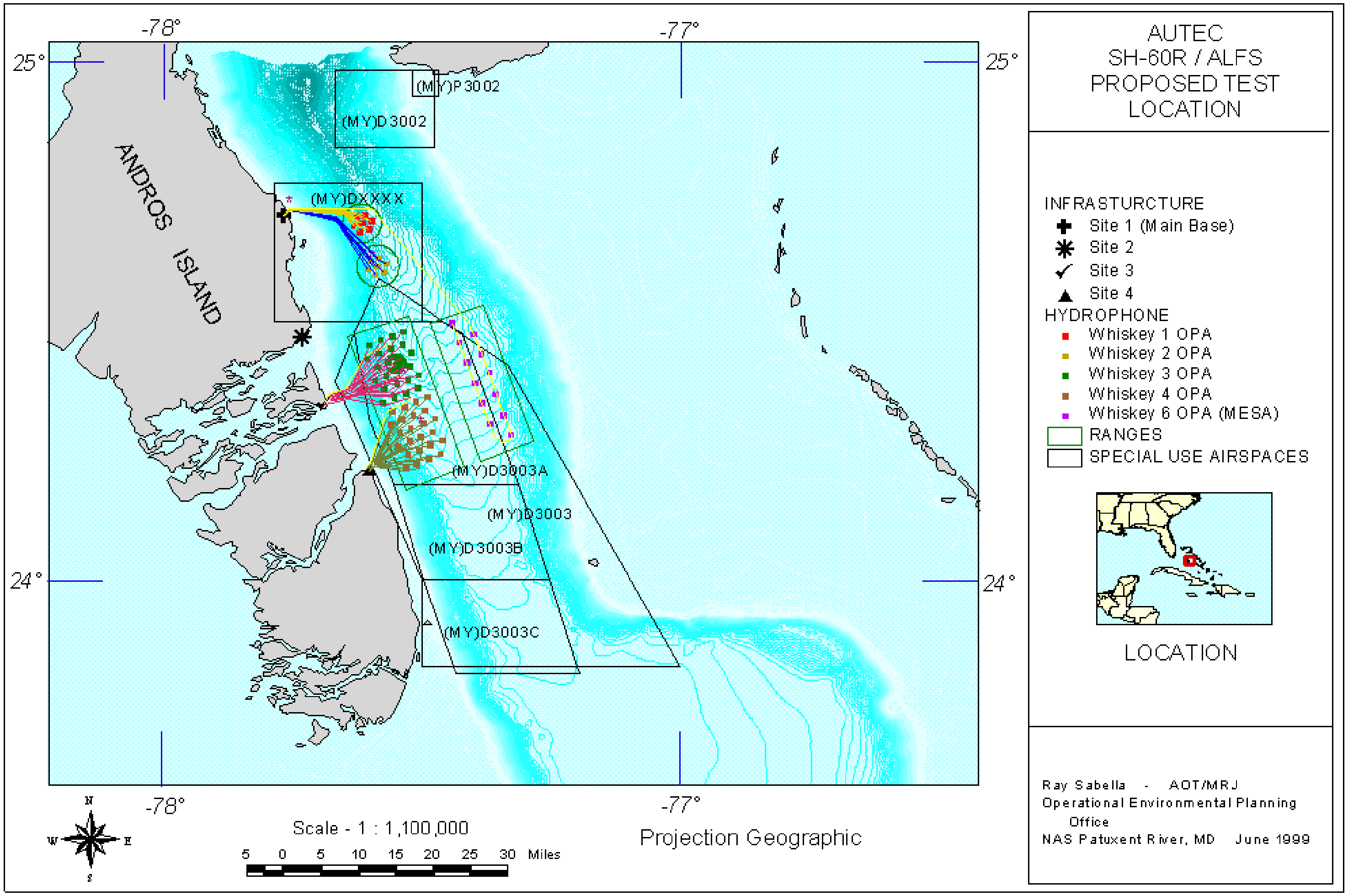

Figure B-5:
Atlantic Under Test and Evaluation Center (AUTEC) Proposed Test Location

Poinsett Weapons Range, Shaw Air Force Base (AFB)

Poinsett Weapons Range is located 7 miles south of Shaw AFB, which is approximately 45 miles east of Columbia, SC and 25 miles south of Camden, SC. Poinsett Weapons Range is a night capable, conventional range that plays host to a diverse group of DoD aircraft. The range encompasses approximately 12,520 acres of which approximately 427 acres are actual impact areas.

Poinsett Weapons Range allows combat aircraft to simulate mission scenarios and deliver practice ordnance on four different ranges. The Electronic Combat Range offers aircraft the ability to test and evaluate electronic warfare (EW) systems and is a critical range for the SH-60R helicopter. Four electronic threat systems are part of this range: the Multiple Threat Emitter System (MUTES), the Mini-MUTES, the Tactical RADAR Threat Generator (TRTG), and the Threat Reaction and Indicator System (TRAINS). MUTES and Mini-MUTES are identification friend or foe (IFF) tracker systems, while TRTG is a skin tracking system and is susceptible to electronic counter measures (ECM). The TRAINS is an excellent system used for capturing, recording, and analyzing ECM received from aircraft in response to the threats generated by the MUTES. TRAINS is a critical system for evaluating EW operational effectiveness.

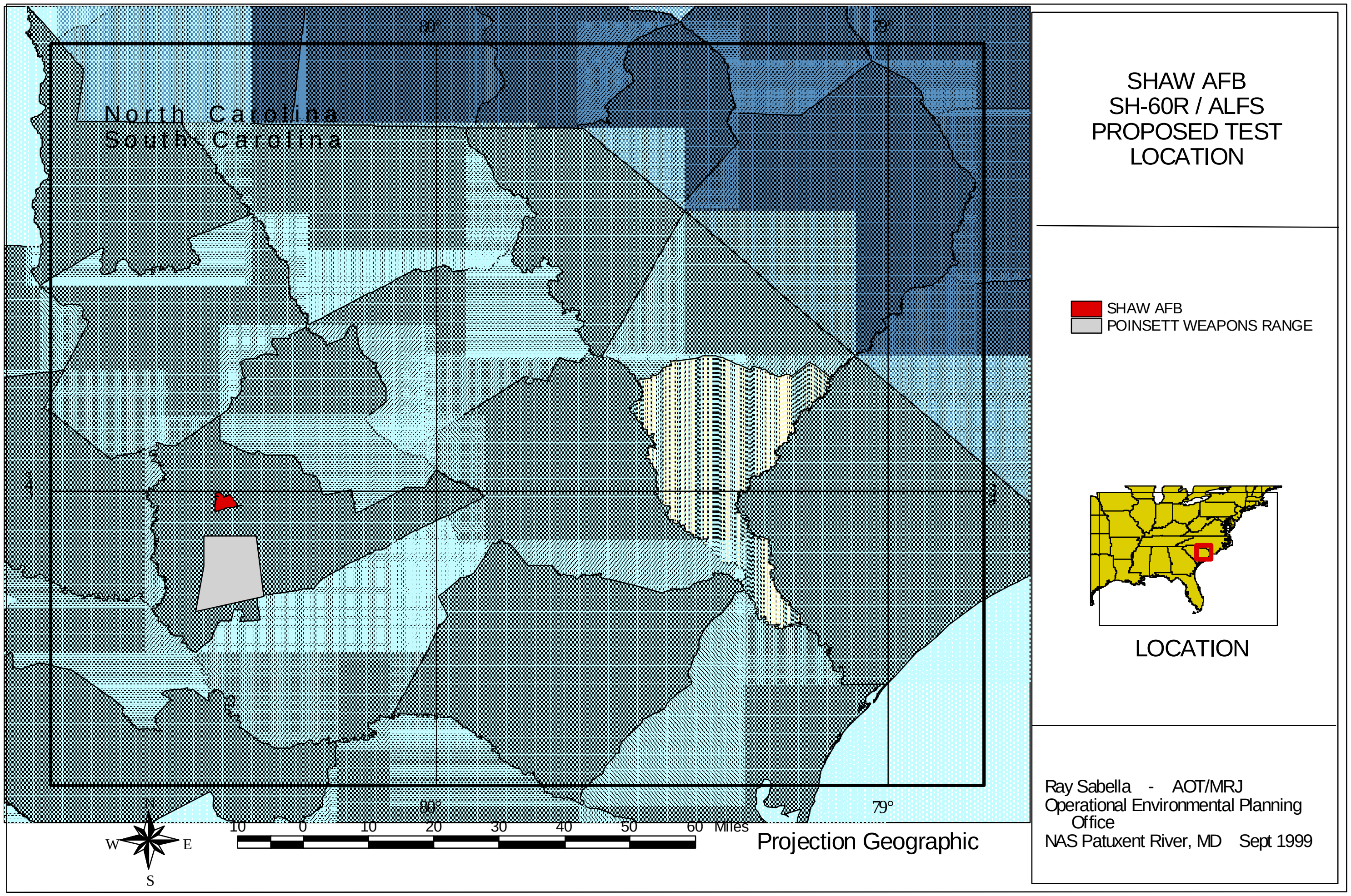

Figure B-6:
Poinsett Weapons Range, Shaw Air Force Base (AFB) Proposed Test Location

APPENDIX C

APPLICABILITY DETERMINATION FOR CONFORMITY FOR NAVAL AIR STATION PATUXENT RIVER COMPLEX

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APPLICABILITY DETERMINATION FOR CONFORMITY FOR NAVAL AIR STATION PATUXENT RIVER COMPLEX

This format follows the step-by-step process outlined in the Chief of Naval Operations *Draft Interim Guidance on Compliance with the Clean Air Act General Conformity Rule* (U.S. DoN, 1994).

Step 1: Is the action in a Federal air quality nonattainment or maintenance area?

Yes

Step 2: Does the action result in the emission of criteria pollutants for which the area is designated nonattainment?

Portions of the Chesapeake Test Range (CTR) lie over two counties in nonattainment status. Calvert County, MD is classified as serious nonattainment and Sussex County, DE is designated as marginal nonattainment for ozone.

Step 3: Is the action in a category considered exempt from Conformity requirements by the U.S. Environmental Protection Agency (EPA)?

No

Step 4: Is the action presumed to conform?

No. However, the Proposed Action is exempt by the general conformity rules.

Step 5: Are the direct emissions associated with the action reasonably foreseeable?

Yes

Step 6: Are the indirect emissions associated with the action reasonably foreseeable?

Yes

Step 7: Can the indirect emissions associated with the action be practically controlled due to continuing program responsibility?

Yes

Step 8: Determination for Total Emissions:

Estimating emissions includes the key items in the DT and OT matrices for the air emissions analysis, which are 1) test location, 2) period of testing, and 3) number of flight hours. Within each test location, flight hours for each year are stated on a per year basis. The yearly number of flight hours is multiplied by the emission factor for this particular helicopter engine.

Helicopter Emission Factors (lbs/h) [1]

Criteria Pollutant: [2]	NO_x	VOC	SO_2	CO	PM_{10} [3]
Per Engine	6.0	0.33	6.3	3.6	0.888
Per Helicopter	12.0	0.66	12.6	7.2	1.776

[1] Memorandum from General Electric, Inc. May 29, 1997; Technical Report, SH-60B T700-GE-401C Engine Evaluation, M. Mulcahy and J. Petz, Naval air Test Center, Patuxent River, MD, 1990; and Technical Manual, Turboshaft Engine Models (T700-GE-401 and T700-GE-401C), A1-T700A-IPB-400.
[2] Nitrogen Oxides (NO_x), Volatile Organic Compound (VOC), and SO_2 emission rates for the T700-GE-401C engine are at maximum power conditions, except for CO and PM_{10}, which are at idle. Assumes JP-5 fuel, with sulfur at the maximum allowable levels of 0.4 percent by weight. Assumes sea level operation at 89°F.
[3] PM_{10} emissions are calculated from emission levels taken from a similar engine. The T58-GE-16 is similar in burn rate to the T700-401C. Technical Manual, Intermediate Maintenance, Turboshaft engine (Model T-58), NAVAIR 02B-105AHC-6-1.

Calculated emission estimates for the SH-60R Test Program are presented in the following table.

Emissions from SH-60R Test Program at NAS PRC

Year	Total Flight Hrs. Per Year	Total Emissions by Air Pollutant (in Pounds)				
		NO_x	VOC	SO_2	CO	PM_{10}
1999	118	1,416	78	1,487	850	210
2000	193	2,316	127	2,432	1,390	343
2001	113	1,356	75	1,424	814	201
2000-2001	45	540	30	567	324	80
Total	**469**	**5,628**	**310**	**5,910**	**3,378**	**834**

Step 9: Are the emissions resulting from the action below the *de minimus* levels?

Yes

Step 10: Is the action regionally significant?

No. An action is considered regionally significant if its emissions will represent 10 percent or more of a nonattainment area's total emission budget for that pollutant. Other than portions of the CTR, NAS PRC is in attainment or unclassifiable/attainment for all six criteria pollutants. Calvert County, MD is classified as serious nonattainment and Sussex County, DE is designated as marginal nonattainment for ozone. However, SH-60R ozone emission rates are well below regulatory standards and are at *de minimis* levels. The two areas within the CTR are not significantly affected.

Step 11: Conclusions.

According to 40 Code of Federal Regulations (CFR) Part 51 subpart W (40 CFR 51.850-860), a conformity determination is required when the emission rates of a Federal action would equal or exceed the *de minimis* levels for a nonattainment area. The amount of pollutants emitted throughout the course of the test program is below *de minimis*. Due to the limited nature of the test, the impacts of the action on air quality in the NAS PRC and CTR area will be insignificant.

RECORD OF NON-APPLICABILITY CONFORMITY ANALYSIS FOR THE SH-60R HELICOPTER/ALFS TEST PROGRAM AT NAVAL AIR STATION PATUXENT RIVER COMPLEX

1. A Conformity Determination is required for any Federal action that may contribute to an increase, above certain applicable emission rates, in a certain pollutant within a designated nonattainment area (NAA). Section 4.1.1.1 of the SH-60R Environmental Assessment/Overseas Environmental Assessment describes or lists the attainment status of the counties potentially affected by the proposed action. Several counties are nonattainment for ozone. Nitrogen Oxides (NO_X) and Volatile Organic Compounds (VOCs) are precursors to ozone; therefore, federal agencies must consider the NO_X and VOC emissions in the conformity review.

2. Emissions for the proposed review are identified in Section 4.1.2 of the SH-60R Environmental Assessment/Overseas Environmental Assessment. The analysis prepared in the Environmental Assessment (EA) looked at the emissions for the SH-60R and its stores during the proposed action. Section 176 of the Clean Air Act Amendments requires federal agencies to review the emissions in nonattainment areas. Total NO_X emissions form the SH-60R testing over three years is small (5,628 pounds), compared to the one year rate for NO_X emissions specified in the Code of Federal Regulations (40 CFR Part 51 Subpart W or Part 93 Subpart B) which is set at 100,000 pounds per year. Thus, the emissions would not trigger a conformity analysis. The VOC emissions are negligible in the proposed action. In terms of CO, worst case emissions are at 3,378 pounds over three years. The CO emissions are below the established applicable emission rates (200,000 pounds per year) under which actions are judged to have no significant impact. Thus, the emissions would not trigger a conformity analysis under the regulations found at 40 CFR Part 51 Subpart W or Part 93 Subpart B. In terms of PM_{10} (particulate matter under 10 micrometers), the worst case emissions are 834 pounds over three years. Similar to CO, the PM_{10} emissions are below the established applicability emission rates (200,000 pounds per year for moderate NAA) under which actions are judged to have no significant impact. Thus, the emissions would not trigger a conformity analysis under the regulations found at 40 CFR Part 51 Subpart W or Part 93 Subpart B.

3. I have reviewed the air emissions analysis portion of the SH-60R Environmental Assessment/Overseas Environmental Assessment and to the best of my understanding and knowledge the information contained within is true and accurate. The analysis shows that no further conformity analysis is required for the SH-60R Environmental Assessment/Overseas Environmental Assessment emissions at the Naval Air Station Patuxent River Complex, Patuxent River, Maryland.

C. A. Schanze

CAPT. C. SCHANZE
U.S. Navy
Public Works Officer

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APPENDIX D

DESCRIPTIONS OF SPECIES FOUND IN THE PROPOSED ALFS TEST AREAS

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DESCRIPTIONS OF SPECIES FOUND IN THE PROPOSED ALFS TEST AREAS

Mysticetes

Mysticetes, or baleen whales, include the largest animals to ever live on earth. They are distinguished by possessing large keratinous baleen plates in their mouths for straining small organisms from seawater. All species of baleen whales are known to produce sound in the low to high frequency. The following mysticetes are potentially in one or more of the testing area and have the potential to hear sounds between 3 and 9 kilohertz (kHz).

Blue whales (*Balaenoptera musculus*) are typically found from the Gulf of St. Lawrence and southern Greenland north to the pack ice during the summer. Their winter range is unknown, but it is assumed to extend from mid-temperate latitudes, perhaps south into the tropics. They have the potential to be found in both the Ex-USS *Salmon* site, Atlantic Warning Area (AWA), and Marine Corps Air Station (MCAS) Cherry Point Operating Area. However, there are no definite records of blue whales south of NJ (Leatherwood and Reeves, 1983). Blue whales produce moans between 12 to 390 hertz (Hz) and clicks between 6 to 8 kHz and 21 to 31 kHz (Richardson, et al., 1995). It is estimated that there are only a few hundred blue whales left in the North Atlantic. The 1998 Stock Assessment Report estimated a minimum population size of 308 animals.

The **fin whale** (*Balaenoptera physalus)* is widely distributed and is found in all oceans of the world in pelagic and coastal areas including the Chesapeake Test Range (CTR), AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. They are currently endangered under the Endangered Species Act (ESA) and protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and classified as endangered by the International Union for Conservation of Nature and Natural Resources (IUCN).

Like blue whales, it is assumed that distribution and movement patterns consist of seasonal migrations between higher latitudes for foraging and lower latitudes for mating and calving (e.g., Lockyer, 1984, Mackintosh, 1965). Recent data indicate that some whales remain year-round at high latitudes (Clark and Charif, 1998) and other areas such as the Gulf of California (J. Urban, UABCS, La Paz, BCS. Mexico, pers. comm.), migrating only short distances of 100 to 200 kilometers (km) (53.9-107.9 nautical miles (nm)) (Agler et al., 1993). Swimming speeds can be very high, with average rates between 9 to 12 km per hour (km/h) (5-7 knots (kt)) (Ray et al., 1978; Watkins, 1981). Calving and mating occur in late fall and winter (Millais, 1906; Mackintosh and Wheeler, 1929; Nishiwaki, 1952; Tomilin, 1957). Specific breeding areas are unknown and mating is assumed to occur in pelagic waters, presumably some time during the winter when whales are in mid-latitudes.

Fin whales produce a variety of low frequency sounds, primarily in the 15 to 200 Hz band (Watkins, 1981; Watkins et al., 1987; Edds, 1988; Thompson et al., 1992;). The most typical signals are long, patterned sequences of short duration (0.5-2 seconds) infrasonic pulses in the 18 to 35 Hz range (Patterson and Hamilton, 1964; Watkins et al., 1987). Estimated source levels are as high as 186 dB (Patterson and Hamilton, 1964; Watkins et al., 1987; Thompson et al., 1992; McDonald et al., 1995).

The **minke whale** (*Balaenoptera acutorostrata*) is found throughout all oceans of the world including the CTR, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. As with other balaenopterids, minke whales migrate to higher latitudes where they feed during the late spring through early fall and to lower latitudes where they breed during the fall through winter. Minke whales are widespread and abundant in the North Atlantic (Stewart and Leatherwood, 1985). They have been commercially exploited since at least 1923 (Kellogg, 1931), but global populations appear to be healthy. Minke whales are listed by IUCN as a lower risk/near threatened species.

Minke whales produce a variety of sounds, primarily in the 80 to 5,000 hertz (Hz) range. In the Northern Hemisphere, sounds recorded include "grunts," " thumps," and "ratchets" from 80 to 850 Hz and pings and clicks from 3.3 to 20 kHz. Most sounds during the winter consist of 10 to 60 second sequences of short 100 to 300 microsecond pulses (Schevill and Watkins, 1972; Winn and Perkins, 1976; Thompson et al., 1979; Leatherwood et al., 1980; Mellinger and Clark, 1997). The function of minke whale vocalizations is unknown, but they are assumed to be used for communication. There are no data on hearing sensitivity for the minke whale. By comparison to what little is known about Balaenopteran auditory mechanics, it is assumed that the minke whale has excellent low frequency (LF) hearing (Ketten, 1994). Additionally, because minke whales produce sound in the mid-frequency range, it is assumed that they can also hear in that range.

The **humpback whale** (*Megaptera novaeangliae*) occurs worldwide including the CTR, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. It is primarily a coastal species that travels over deep pelagic waters during migrations between higher latitude feeding areas and lower latitude breeding areas. Almost all feeding occurs during the late spring through early fall in mid-to-high-latitude areas in shallow coastal waters or near the edge of a continental shelf. Calving takes place in shallow waters in isolated tropical areas from late fall through late winter near the West Indies and Trinidad in the west, and the Cape Verde Islands and off northwest Africa in the east. Breeding is assumed to take place in or near these calving areas during the same period. Data indicate that not all animals migrate during the fall from summer feeding to winter breeding sites and that some whales remain year-round at high latitudes (Christensen et al., 1992; Clapham, et al. 1993). They are currently endangered under the ESA and protected under CITES, and classified as endangered by the IUCN.

Humpback whales produce a great variety of sounds in a range from 20 Hz to 10 kHz. During the breeding season males sing long, complex songs, with frequencies in the 25-5,000 Hz range and intensities as high as 190 dB (Payne and McVay, 1971; Winn et al., 1970a; Thompson et al., 1986). The songs appear to have an effective range of approximately 10 to 20 km (06-12 nm). Social sounds in the breeding areas extend from 50 Hz to more than 10 kHz with most energy below 3 kHz (Tyack and Whitehead, 1983;

Richardson et al., 1995). Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz (Thompson et al., 1986). These sounds are attractive and appear to rally animals to the feeding activity (D'Vincent et al., 1985; Sharpe and Dill, 1997).

Northern right whales (*Eubalaena glacialis*) migrate through the AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. From late winter to fall they breed and give birth in temperate shallow areas off the coasts of GA and FL, migrating into higher latitudes where they feed in coastal waters during the winter through fall. Right whales are endangered under the ESA, protected under CITES, and classified as endangered by the IUCN. There is no hearing data available for the northern right whale, but it does produce moans at about 400 Hz.

Odontocetes

Most species of odontocetes are known to produce sounds (mostly in the mid-to high-frequency range), and several are known to use sound for communication (Norris and Dohl, 1980; Watkins et al., 1985; Weilgart and Whitehead, 1990). Odontocetes studied have been found to echolocate much as bats do by using echoes from their own high frequency and ultrasonic pulses to determine the direction, range, and characteristics of objects in the water (Richardson, et al., 1995; Au, 1993, 1997; Norris, 1994). This is the basis for the general assumption that all odontocetes use echolocation. Although it is also generally assumed that odontocetes use echolocation to find food, to navigate, and to orient, empirical data are limited.

Richardson et al. (1995) reviewed the limited research on hearing ranges in odontocetes. Of the eight species studied (which did not include the sperm or beaked whales), the low end of the range was found in bottlenose dolphins (40-75 Hz). The hearing range of at least some individuals of all eight of the species tested extended up to 80 to 150 kHz. However, for the species studied, hearing was most sensitive and acute in the middle frequencies of 10 to 100 kHz.

Sperm whales (*Physeter macrocephalus*), the largest odontocetes and probably the deepest cetacean divers, could be found in the CTR, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. Sperm whales exhibit a clumped distribution, being found in high concentrations in areas called "grounds." The most important historical grounds in the North Atlantic are the Grand Banks, off the Carolinas, around the Bahamas, off the west coast of the British Isles, and from the Azores and Madeira across the tropical mid-Atlantic. They are currently endangered under the ESA and protected under CITES. Sperm whales have been recorded to dive to depths of more than 3,000 meters (m) (9,800 feet (ft)), with dives lasting as long as two hours (Clarke, 1976; Watkins et al., 1985). Typical foraging dives last about 40 minutes and descend to about 400 m (1,300 ft), followed by eight minute rest at the surface (Gordon, 1987: Papastavrou et al., 1989). The frequency range of sperm whale clicks is from less than 100 Hz to 30 kHz, with most energy at 2 to 4 kHz and 10 to 16 kHz (Watkins and Schevill, 1977; Watkins et al., 1985, both in: Richardson et al., 1995).

The **pygmy and dwarf sperm whales** *(Kogia* spp.) are small, relatively solitary, apparently deep-diving, whales that live in temperate to tropical deep waters from 60°N to 40°S around the world. They are especially common along continental shelf breaks (Evans, 1987; Jefferson et al., 1993) and could be found in the AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. There are no data on vocalizations in the wild for either pygmy or dwarf sperm whales. Recent recordings from captive pygmy sperm whales indicate that they produce sounds between 60 and 200 kHz with peak frequencies at 120-130 kHz (Santoro et al., 1989; Carder et al., 1995). An auditory brainstem response study indicates that pygmy sperm whales have their best underwater hearing range between 90 to 150 kHz (Carder et al., 1995).

Northern bottlenose whales (*Hyperoodon ampullatus*) are the largest of the species in the family Ziphiidae, and the second largest of all the toothed whales. Gregarious northern bottlenose whales are a cold temperate-to-subarctic species found in the North Atlantic, mostly seaward of the continental shelf in water deeper than 1,000 m (3,300 ft) (Leatherwood and Reeves, 1983; Jefferson et al., 1993). They could be encountered in the AWA. Northern bottlenose whales produce echolocation-type clicks between 8-12 kHz, whistles between 3 to 16 kHz, and clicks between 500 Hz and 26 kHz (Winn et al., 1970b). Off Nova Scotia, predominant sounds are click series and trains ranging from 2-20 kHz (Hooker and Whitehead, 1998).

Cuvier's beaked whale (*Ziphius cavirostris*) is one of the most abundant and widespread species in the family Ziphiidae and could be encountered in the CTR, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. They are found in deep, offshore waters of all oceans, from 60°N to 60°S (Jefferson et al., 1993), but are more common in subtropical and temperate waters than in the tropical and subpolar waters of their range (Evans, 1987). They typically are found in groups of two to seven (Heyning, 1989; Jefferson et al., 1993) and usually travel at a pace of 5 to 6 km/hr (2.7-3.2 kt) (Houston, 1991). No sound or hearing data are available.

Beaked whales include 12 species of the genus **Mesoplodon** deep-diving, but poorly studied, pelagic whales which are distributed throughout the world's oceans between 72°N and 60°S (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Carlstrom et al., 1997) and could be encountered in the AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. New species have been described as recently as 1997, and undescribed species may still exist. Mesoplodon species are most commonly seen as single individuals or pairs, sometimes trios. Since it is almost impossible to distinguish between species of Mesoplodonts in the field, this genus is typically described as a group. Hubb's beaked whales produce sound from 0.3 to 80+ kHz. Blainville's beaked whales produce sounds from <1kHz to 6 kHz. No hearing data is available, but it is assumed that beaked whales can hear signals between 1 and 10 kHz.

Pilot whales, including the short-finned and long-finned (*Globicephala* spp.), are relatively large, deep-water, oceanic species that occur in temperate and subpolar zones from 20° to 75°N (Nelson and Lien, 1996) and could be encountered in the AWA, Ex-*Salmon* Site, and MCAS Cherry Point Operating Area. Vocalizations have been correlated with behavioral state and environmental context (Taruski, 1979; Weilgart and

Whitehead, 1990). Long-finned pilot whales produce sounds as low as 500 Hz and as high as 18 kHz, with dominant frequencies between 1 to 11 kHz (Schevill, 1964; Busnel and Dziedzic, 1966; Taruski, 1979; Steiner, 1981; McLeod, 1986). Short-finned pilot whales produce vocalizations as low as 280 Hz and as high as 100 kHz, with dominant frequencies between 2-14 kHz and 30-60 kHz (Caldwell and Caldwell, 1969; Fish and Turl, 1976; Scheer et al., 1998). No hearing data are available.

Risso's dolphin (*Grampus griseus*) is a medium-sized odontocete that inhabits deep oceanic and continental slope waters from the tropics through the temperate regions from 55°S to 60°N (Leatherwood et al., 1980; Jefferson et al., 1993) and could be encountered in the AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. Groups of Risso's dolphins average between 6 and 63 individuals, but groups can reach up to 2,000 (Braham, 1983; McBreanty et al., 1986; Kruse, 1989; Wade and Gerrodette, 1993; Miyashita, 1993). Risso's dolphins produce sounds as low as 100 Hz, with dominant frequencies at 2 to 5 kHz and at 65 kHz (Watkins, 1967; Au, 1993). Published audiograms for Risso's dolphins indicate hearing at frequencies as low as 75 Hz (Johnson, 1967). More recent audiograms obtained on Risso's dolphin (Au et al., 1997) confirm previous measurements and demonstrate hearing thresholds of 140 dB at a frequency of 75 Hz, 127 dB at a frequency of 1 kHz, and 70 dB at a frequency of 4 kHz.

The two **common dolphin species, the short-beaked and long-beaked** (*Delphinus delphis*), are distributed worldwide in temperate, tropical, and subtropical oceans, primarily along continental shelf and bank regions from about 66°N to 55°S (Evans, 1994) including the AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. Common dolphins can be found in groups that reach thousands of individuals; however, the basic social unit may be less than 30 dolphins (Evans, 1994). Common dolphins produce vocalizations as low as 200 Hz and as high as 150 kHz, with dominant frequencies at 0.5-18 kHz and 30-60 kHz (Caldwell and Caldwell, 1968; Popper, 1980; Au, 1993; Moore and Ridgway, 1995). The maximum peak-to-peak source level of common dolphins is 180 dB (Popper, 1980). Based on auditory brainstem responses, common dolphins listen underwater to sounds equal to or softer than 120 dB in the range of <5 kHz to 150 kHz (Popov and Kishin, 1998). The best underwater hearing of the species occurs at 65 kHz, where the threshold level is 53 dB (Popov and Kishin, 1998).

Four species of **Stenella dolphins--striped, Atlantic spotted, spinner, and Clymene** (*Stenella* spp)**--**inhabit coastal and oceanic tropical and subtropical waters worldwide from 40°S to 40°N (Perrin and Gilpatrick, 1994; Perrin and Hohn, 1994) and could be encountered in the AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. They are very gregarious, and groups can vary from dozens to thousands depending upon the species and the geographic area (Miyashita, 1993; Wade and Gerrodette, 1993; Suarez-C. et al., 1994; Jefferson, 1995; Acevedo-Gutierrez and Burkhart, 1998). Dolphins of the genus Stenella vocalize as low as 100 Hz and as high as 160 kHz with dominant frequencies at 5 to 60 kHz, 40 to 50 kHz, and 130 to 140 kHz (Busnel et al., 1968; Caldwell and Caldwell, 1971; Caldwell et al., 1973; Popper, 1980; Watkins, 1980; Steiner, 1981; Zanardelli et al., 1990; Mullin et al., 1994; Norris et al., 1994; Wang Ding et al., 1995; Au et al., 1998; Ketten, 1992; Richardson et al., 1995). Peak-to-peak source levels as high as 210 dB have been measured (Au et al., 1998). The best underwater hearing of the species appears to be at 50-70 kHz, where the threshold level is 30 to 40 dB (Popper, 1980).

The much-studied and generally abundant **bottlenose dolphin** (*Tursiops truncatus*) is distributed worldwide in temperate to tropical waters and could be encountered in all of the airborne low frequency sonar (ALFS) test areas. In the western North Atlantic, the bottlenose dolphin has been divided into an offshore and inshore stock (Waring et al., 1998). The offshore stock is a deep, cold water species, concentrated along the continental shelf break and extending beyond the continental shelf into continent slope waters in lower concentrations. The coastal stock is a shallow, warm water species whose structure is uncertain. North of Cape Hatteras, NC, the coastal stock displays seasonal changes in abundance and distribution consistent with a migratory population (Kenney, 1990).

Bottlenose dolphins produce vocalizations as low as 50 Hz (Johnson, 1967) and as high as 150 kHz with dominant frequencies at 0.3 to 14.5 kHz, 25 to 30 kHz, and 95 to 130 kHz (Popper, 1980; McCowan and Reiss, 1995; Schultz et al., 1995; Richardson et al., 1995). Each individual bottlenose dolphin has a fixed, unique contour and a whistle composed of similar, repetitive elements called loops (Caldwell et al., 1990). They listen underwater to sounds equal to or softer than 120 dB in the range of 150 Hz to135 kHz (Johnson, 1967; Ljungblad et al., 1982). Their best underwater hearing occurs at 15 kHz, where the threshold level is 42 to 52 dB (Sauerland and Dehnhardt, 1998). Echo-locating dolphins can detect targets at ranges of approximately 100 m (330 ft), depending upon the size of the targets (Au, 1997). Target discrimination experiments have shown that bottlenose dolphins can discriminate the shape, size, material composition and internal structure of targets from the echoes (Au, 1997).

Atlantic white-sided dolphins (*Lagenorhynchus acutus*) primarily inhabit coastal temperate and cold waters; but they also occur in deep, offshore waters including the AWA and Ex-USS *Salmon* site. Species in this genus produce sounds as low as 60 Hz and as high as 325 kHz with dominant frequencies at 0.3 to 5 kHz, 4 to 15 kHz, 6.9 to 19.2 kHz, and 60 to 80 kHz (Popper, 1980; Richardson et al., 1995). Pacific white-sided dolphins listen underwater to sounds equal to or softer than 120 dB in the range of about 500 Hz to 135 kHz (Tremel et al., 1998).

Harbor Porpoise (*Phocoena phocoena*) are found in cool temperate and subpolar waters of the Northern Hemisphere including the CTR, Ex-USS *Salmon* site, and AWA. They are typically found in shallow water, most often nearshore, although occasionally they travel over deeper offshore waters (Jefferson et al., 1993). Along the Atlantic coast, harbor porpoise are concentrated in Canada and Northern ME during the summer, and are thought to extend their range to NC during the spring and fall (Blaylock et al., 1995). Little is known about other migration patterns of harbor porpoises, but inshore-offshore migration in the summer and winter has also been suggested for some populations (Martin, 1990). Most harbor porpoise groups are small, consisting of less than eight individuals, but when feeding or migrating, they can expand to loose groups of 50 to several hundred animals.

Pinnipeds

Harbor seals (*Phoca vitulina*) are widely distributed from subarctic to the temperate waters. This species is relatively abundant, have a broad diet, make no clear long distance migrations, and are seasonally monogamous or mildly polygynous breeders. They have all been hunted commercially or in an attempt to reduce population sizes (Croll et al., 1999). Harbor seals have a hearing range from 1 to 180 kHz. They are potentially found in the areas of the AWA, Ex-USS *Salmon* site, and CTR.

Sea Turtles

There are three species of sea turtle that could potentially be found at one or more of the test sites. Little is known about the hearing ability of sea turtles, except that they are thought to be able to perceive low frequency sounds.

The **leatherback turtle** (*Dermochelys coriacea*) is the largest, most pelagic, and most widely distributed of any sea turtle from 50^{o}N to 35^{o}S and could be found in the CTR, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. It rarely stops swimming and individuals have been monitored swimming in excess of 13,000 km (7,014.8 nm) per year (Eckert et al., 1989). From April to November, leatherbacks can be found north of Cape Hatteras, NC. They are frequently sighted during aerial surveys of Chesapeake Bay, especially at the mouth of the Bay and during the summer. From Cape Hatteras to Key West, FL, leatherback turtles are found year round out to the western boundary of the Gulf Stream. (NMFS/U.S. FWS, 1992). It is an endangered species under the ESA and CITES.

The **loggerhead turtle** (*Caretta caretta*) is a large, widespread turtle that feeds primarily on benthic invertebrates (Ernst et al., 1994; Bjorndal, 1997). Loggerhead turtles reside and nest in subtropical to temperate areas (e.g., NC to FL) and could be found in the CTR, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. Loggerhead turtles have stranded year round in the Mid-Atlantic Bight (National Aquarium, 1997). As hatchlings, they undertake long developmental migrations. Hatchlings on the eastern coast of the United States (U.S.) cross the Atlantic before they return to the coastal waters near where they were hatched (Wyneken, 1997). They are listed as threatened under the Endangered Species Act and are protected by CITES.

The **green turtle** (*Chelonia mydas*) is widespread throughout tropical and subtropical waters and could be found in the CTR, AWA, Ex-USS *Salmon* site, and MCAS Cherry Point Operating Area. Hatchlings and young turtles are pelagic and omnivorous, but juveniles and adults forage on benthic algae and sea-grasses. They are, therefore, primarily coastal as juveniles and adults, but make long pelagic migrations between foraging and breeding areas (Bjorndal, 1997; Pritchard, 1997). Population sizes are not known, but they appear to be declining, at least since the 1950s, and the FL breeding population is considered endangered by under the ESA and protected by CITES.